POULTRY INCUBATION AND BROODING

A Professional Approach to Optimal Results

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DEDICATION

This book is dedicated to the millions of people out there yearning to receive knowledge about incubating and brooding poultry!

ACKNOWLEDGMENTS

I am forever grateful for the generosity of the poultry farmers who have shared their knowledge with me, either in presentations, videos, books, forums, or formal research. I am particularly grateful to those whose examples and photos are contained in the book. They have been overwhelmingly generous in sharing their wisdom so that the reader can better understand this amazing concept of incubation and brooding. Finally, I must acknowledge the love, kindness, and patience my wife and sons showed me throughout this process.

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Emmanuel Mwesige is an experienced and knowledgeable business administrator with a passion for writing and agriculture. The author holds a bachelor's degree in Business Administration (Accounting) from Makerere University. Throughout his career, he has dedicated himself to honing his skills and expanding his knowledge in various subjects within the agriculture sector. He possess a deep understanding of the agricultural sector and has embarked on putting in black and white whatever topic he picks interest in. He is authoring a number of books in the area of agriculture!

PREFACE

The reproduction of the flock from year to year is one of the poultry raiser's most important problems.

To insure success in incubation and brooding, hatching eggs must come from breeding stock of the highest possible quality and free from disease.

Growers find incubators and brooders economical and labour saving in reproducing the flock.

Proper temperature and ventilation and an adequate supply of moisture are essential to success in incubation.

Good breeding calls for temperature control according to the weather and the age of the chicks, plenty of room, not more than 400 chicks in the flock, good ventilation, and clean house and soil.

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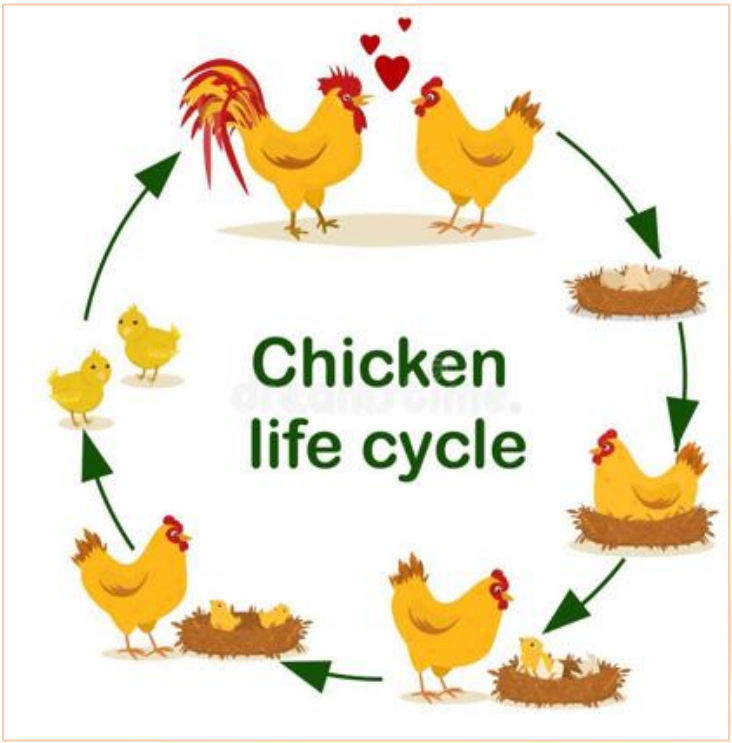
INTRODUCTION TO INCUBATION AND BROODING

Under this section we shall cover:

- Understanding the life cycle of poultry
- Selecting the right breeds for incubation
- Types of incubation
- Choosing the right egg incubation
- Selecting eggs for hatching
- Preparing the incubator
- Incubation techniques and best practices
- Temperature, humidity and ventilation control
- Setting eggs
- Turning eggs and managing airflow
- Candling and assessing egg development
- Pre-hatching
- Hatching and caring for chicks

Understanding the Life Cycle of Poultry

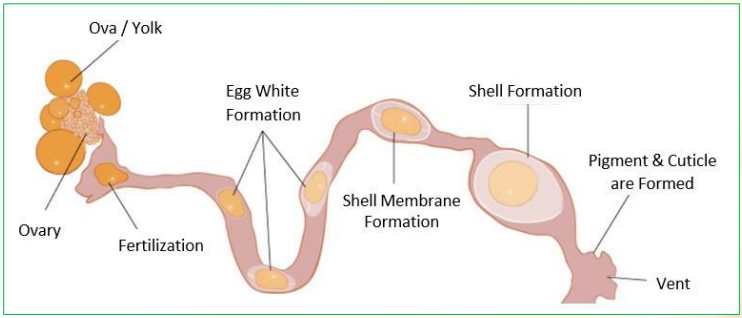


We all know the age-old question- what came first, the chicken or the egg? And while this questions remains unanswered, there is a lot more to know about a chickens life cycle that we will happily clear up for every potential and actual poultry farmer!

Egg

To lay a clutch of fertilized eggs, a hen must have first mated with a rooster. The hen will then form an egg- a process which takes approximately 25 hours.

This process will begin with the formation of the egg yolk, it is produced by the hens ovary during the ovulation process- the yolk is referred to as the oocyte at this stage. As it travels down the oviduct, it will be fertilized internally by the sperm of the rooster.



As it continues to travel down the oviduct it becomes covered with a white membrane called 'vitelline membrane', as well as some layers of the egg white or 'albumen'. Still travelling further down the oviduct, a casing for the egg white and yolk will begin to form. Eventually, the shell will be completely developed, and thus the egg is completely formed!

The hen will then lay this new life form in a comfortable and quiet spot. A hen will generally lay a clutch of approximately 12 eggs, with each egg being laid a day apart.

Chick

If hatching naturally, the mother hen will sit on the eggs to maintain the optimum temperature so they can develop until it is almost hatching time. Sometimes hens will not take to sitting on their eggs, and so a farmer may need to purchase an incubator and do this step him/herself.

The chick inside the egg will generally grow for 21 days, using the egg yolk as a means of nutrition as it grows. Along with sitting on the eggs, the hen will also use her beak to turn them to aid their development.

On about day 19 of the incubation period, the chicks will begin the pipping process. This involves the baby chicks using their 'egg tooth' to peck a hole in the eggshell around the air sac to access oxygen, before pipping an area large enough for it to be free of its shell. This process can take up to 24 hours and should not be rushed.

The chicken will emerge with wet 'down' feathers, however they dry quickly, and will be extra fluffy and adorable in no time. Most chickens are able to stand and walk about straight after birth, however some may be a bit wobbly at first.

After birth, a baby chicken will need to be placed in a brooder- an indoor space that is heated up by the heat of an infrared lamp. The chickens will remain in the brooder for the first few weeks of their life- they will be fed in the brooder and sleep in the brooder, so it is important that it is cleaned regularly, so the chickens can remain at the height of their health.

A chick will start developing its first true feathers at around 5 days old, and at approximately 12 days the chick will begin to show defining breed bone

development, as will it's wing feathers. By day 18, the chicken should have significant feathering, and by day 30, it will have developed the characteristics that identify it with its breed.

Unfortunately many young roosters are discarded as soon as they can be sexed- especially if they were being bred for egg production. Some may be kept and raised for meat, or to produce the next generation of chickens, but for most this is not the case.

A chick will continue to grow and develop- learning common chicken behaviours such as roosting and foraging under the guidance of their mothers. Within six months the bird will have developed all of its adult features, and at this stage its considered a mature chicken.

Chicken

Younger hens are known as pullets and may be ready to lay as young as 18 weeks, however this

will vary between breeds. All birds tend to come into lay earlier during periods of increasing sunlight, or later if they reach maturity in early winter.

A healthy and productive female hen will lay eggs until they are about 72 weeks old, however this will also depend on the period of their first moult.

Birds have an annual moult and grow lovely new feathers in their place. This generally occurs in late summer or early Autumn, and the result is a tatty and quite alarming looking bird. During moult, chickens will generally cease egg production, although they may lay one here and there, as all

their energy and nutrients are going into producing a delightful new covering of feathers.

While many birds will start laying again in no time at all, older birds may be expended from their egg laying days, and their egg production will dwindle significantly.

As hens get older, they will start showing signs of their age. A wrinkled and dull face, heavy eyes, increasing rear size, and lack of energy are all

possible indications that a chicken is approaching old age. Despite this, they will still remain the delightful creatures they once were through to their very last days.

So while we do not know whether the chicken or the egg came first, we do know that one does not exist without the other, and both make up the fascinating life-cycle of our favourite feathered friends!

INCUBATION

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Incubation means maintaining conditions favorable for developing and hatching fertile eggs.

An egg must be fertile to hatch. Most market eggs found in grocery stores are not fertile. A fertile rooster is essential for the production of fertile eggs. Studies indicate that the egg a hen lays as soon as one day after breeding can be fertile. The fertility

and hatchability of eggs produced by a flock and the vigor of the chicks depend on both genetic potential and the environment. The parents' age, nutrition, health, physiological condition and environment will affect the setting egg and hatching chick.

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In a small flock, good fertility may be expected within four days following introduction of vigorous males into a flock of females. If the males are removed from the flock, the eggs will show a decline in fertility within four or five days yet may remain at a satisfactory level for up to one week. The semen storage ability of the female fowl may

allow fertile eggs to be laid for more than three weeks after removal of the males.

The female domestic turkey can store semen for even longer periods and lay fertile eggs as long as 200 days after mating. Hatchability and fertility of eggs tend to decline yearly as a flock ages. The pullet year is the most fertile for the fowl.

Selecting the Right Breeds for Incubation

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Whether an individual is considering raising chickens in his/her own backyard or have an established farm suitable for free range chickens, he/she is probably wondering how to choose between the vast numbers of chicken breeds available. Beyond choosing whether one will raise chickens for eggs or meat, there are a few things that need to be considered before settling on a particular breed.

Here are some helpful tips to narrow a farmer's choices, along with a few suggested breeds that do well in a variety of environments.

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- **Climate tolerance:** Each breed of chicken has its own climate tolerance. Be sure to select breeds for the area of the country where the chickens will be raised. While most birds can adapt to cold conditions, many have trouble in hotter climates. Heavier birds tend to do best in cooler areas of the country, while lighter birds do better in hotter climates. Some breeds do well in both cold and hot climates.
- **Available space:** Consider how much space available to be devoted to flock and choose birds accordingly. Active breeds are best raised on open farm land with lots of space. They do not handle confinement well. However, many chicken breeds have calm temperaments to

handle close confinement in backyard or urban settings.

- **Temperament:** If a farmer is just beginning his/her chicken raising adventure or wants his/her children to interact with the birds, choose breeds with docile temperaments. Choosing docile birds is also a good idea when raising chickens in smaller spaces or in an urban or suburban environment.
- **Egg production:** If a farmer is raising chickens primarily for their eggs, he/she should be sure to choose a breed with good to excellent egg production. Good egg production ranges from 125 to 175 eggs per year, per hen. Very good production ranges from 150 to 200 eggs per year, per hen. Excellent production exceeds 230 eggs per year and some can yield as many as 300 eggs a year under the right conditions.

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- **Egg size and colour:** While this is a minor consideration, if egg size or color is important to a poultry farmer, he/she will want to choose his/her chicken breed accordingly. Most breeds produce brown or white eggs, but some, like Easter Eggers, can produce eggs in multiple colors. The size of the eggs can make a difference in a farmer's yield as well. Generally, smaller breeds produce smaller eggs, so if one wants large eggs, he/she should look for larger, heavier breeds.
- **Maturation rate:** If chickens are to be raised for meat production, a farmer will want to look at the maturity rate of birds that interest him/her. Meat breeds are generally bred for fast growth to maximize meat production. Maturation rate can also be an important consideration when raising laying chickens.

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Some breeds mature more rapidly than others, producing eggs at an earlier age.

Types of Incubation

Poultry eggs Incubation to be either by natural or industrial incubation.

Natural Incubation of Eggs

Natural incubation is a method used for hatching poultry eggs without the use of incubators. This method is commonly used in small-scale poultry

farming and involves setting eggs in a natural brooding environment. It allows the hens to brood the eggs and provide them with the necessary warmth and care until they hatch.

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A farmer can let the hens incubate the eggs and rear the chicks, or he/she can collect the eggs and incubate them artificially. The natural brood hen method will be less expensive but will produce fewer chicks. If several hens are allowed to brood a clutch at the same time, a farmer may need

additional nests to accommodate the hens of the flock that are still laying.

Constructing the Laying Nest

The nest should be roomy to prevent the eggs from being broken by the hen and to provide for her comfort. Sitting hens prefer to brood in a quiet, out-of-the-way place that is protected from enemies. A suitable bank of nests should be 36 inches long, 12 inches high, and 14 inches deep. Place a partition every 12 inches apart in the bank to provide for three nests. A longer bank of nests may be made if desired and partitioned at 12-inch intervals. The front of the nest should be made of wire to safeguard against invasion by rodents and to keep the nest cool.

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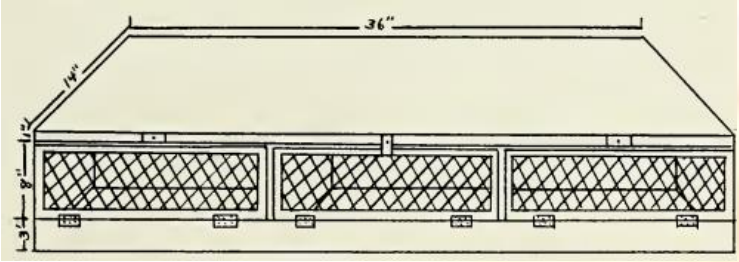

Place the nest on the ground unless the rats or other enemies are prevalent, in which case build the nest

in a poultry house that is rodent proof. When the nests are to be made in the poultry house, or above the ground, put a piece of grass sod or some dampearth in the bottom of the nest and hollow it slightly in the center before adding the nesting material. The sod or damp earth will provide suitable moisture conditions for successful hatching.

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Also, locally made laying nests can be used. Items like old baskets, car tyres, buckets, among others can be modified and used as laying nests for the hens.

Setting the Hen

Transfer the hen at night to the place where she is to remain for the hatching period. Before placing

her on the nest dust her with sodium fluoride powder, working it well into the feathers, especially those around the vent and under the wings.

Advice

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To dust hen, hold her by the legs head down and rub pinches of sodium fluoride well into her feathers especially around:

- Base of tail
- Below vent
- Both sides of keel bone
- Outside thigh region, both legs
- Along wings
- On back, just back of wings
- Throat
- Back of head

Note: Sodium fluoride is a poison and must be kept stored where children cannot accidentally get it. Wash hands thoroughly after using sodium fluoride.

Do not place the eggs in the nest until the hen has remained there for a day or two. Place infertile or artificial eggs in the nest for the first day or two. If the hen remains on the nest place 12 to 15 eggs for hatching under her. The number will depend upon the size of the hen. If the nest has been used previously, carefully inspect it for lice and for mites and if they are present clean and spray the nest, using commercial poultry-house spray. Cleanliness is very essential for success in natural incubation.

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Feeding the Incubating Hen

Place before the hen at least once each day whole grains, greens, grit, charcoal, and fresh water. No wet mash or dry mash is fed during the sitting period. A dust bath should be placed where the hen may have free access to it during feeding time. Placing a small quantity of a mixture of tobacco dust and earth in the dust bath will aid in exterminating lice and mites.

Broody Hens – Nature's Incubators

A hen must be broody (a physiological state in which the hen desires to sit on eggs) before she is used for incubating eggs. Some strains of birds such as the Leghorns seldom become broody. Broody hens may be identified by their tendency to sit on the nest even when not laying an egg; they also cease laying, develop a "clucking" voice and become protective and possessive of the eggs.

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Signs of broodiness in hens

Some of the following symptoms and signs may occur when a hen is broody.

- Makes characteristic clucking sounds especially when disturbed.
- Chest and belly feathers are missing. This is as a result of the hen plucking these feathers to help improve heat transfer from her body to the eggs.

- Pecking a person's hand or biting him/her when he/she checks for eggs underneath her.
- The broody only leaves the nest once or twice a day and quickly returns after a quick bite and drink.
- Remains sitting on her eggs. A hatchability of 80% (of eggs set) from natural incubation is normal but a range of 75-80% is considered satisfactory.
- Sitting in the nest even when there are no eggs
- Chest and belly feathers are missing.
- Produce abnormally large droppings

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Advantages of Natural Incubation of Eggs

- The hen acts as both the incubator and the brooder box. No heat lamps or electricity needed!
- The hen turns the eggs, ensuring they each spend equal amounts of time on each side and

rotate from the center to the edges of the nest for even warming.

- It is said that broodies can detect non-fertile and non-developing eggs and will kick them out of her nest - no need to even candle the eggs.
- Because the broody has plucked out her breast feathers to allow skin-to-egg contact, she regulates the humidity in the nest.
- If only one chick hatches, it will not be all alone as a brooder baby would be, since it will have the mother hen for company.
- The mother hen will teach her chicks to drink, teach them what to eat and where to find bugs and weeds, and also teach them the dangers of predators and how to take dust baths.
- A good broody will judge the ambient temperature and could have her chicks outside for short 'field trips' in just a few days, thereby allowing them exposure to the pathogens and

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bacteria in the environment and beginning to build strong immune systems.

- Since the rest of the flock will be used to the chicks being in the coop and run right from hatch, they are far more likely to accept them without any trouble.

Disadvantages of Natural Incubation of Eggs

- The breaking of eggs may occur due to faulty sitting of broody hen.
- This method is not suitable for hatching large number of eggs at a time.
- Some hens do not sit the entire 21 days and will abandon their nest partway through - in which case an incubator should be a farmer's Plan B.
- Timing the hatch can be tricky since a farmer cannot 'force' a hen to go broody, so ordering fertile eggs to arrive at the same time as a farmer has a broody hen can take some coordination.

- Disease transmission from hen to chicks is higher.
- Not all broodies make good mothers and once the chicks hatch, will sometimes lose interest in caring for them, or worse, kill them, so a farmer should have an indoor brooder box at the ready just in case.
- Both the hatching eggs and baby chicks are vulnerable to predators such as rats and snakes in addition to other flock members, so a poultry farmer will need to be sure the nest his/her broody has made is in a safe place and once the chicks hatch, he/she moves them to a safe crate, cage or pen inside the coop.

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Farmers' Frequently Asked Questions Answered

How to tell if a hen is broody?

Put an egg in front of her, a broody hen usually cannot resist moving the egg underneath her. Often, if the hen is picked up and placed somewhere else, she will fluff out her feathers and just proceed to nest in that very location for a few moments, before eventually making her way back to her nest.

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How long does a broody sit to hatch eggs?

Chicken eggs take 19 to 21 days typically to hatch. Late hatches on days 22 and days 23 are not unusual. Always remember that eggs are not on a timer and that chickens cannot tell time and do not have calendars. Just like with humans, some babies come early and some come late.

How long will my broody sit after her hatch starts?

Typically a broody hen will sit for 36 hours after the 1st chick is born. After that point, even if all of the eggs are not hatched, she will need to get off the nest to feed her little ones. At this point some hens are finished sitting. I have heard other hens feed their little ones then return to sitting. Hens vary in behaviour. The former is more common than the later.

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I have a broody hen but do not yet have fertile eggs?

If you would like to have your broody hen hatch eggs but do not have fertile eggs, give the broody hen either real unfertile eggs, fake eggs, or even golf balls to sit on until you get fertile eggs. There are several ways to get fertile eggs. There are several venues online to purchase fertile eggs. My preferred way is to check locally, check local farms. If all else fails ask your friend who has chickens.

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How long will my broody take care of her chicks?

That varies hen to hen. Some hens are done raising them when the chicks are 4 weeks old. This is really nothing to worry about. Mama Hen has taught them how to be chickens. Other hens take care of their little ones for 12 weeks or any length of time between.

My broody hen is mean and is attacking me!

No, she is doing her job of protecting her babies. Even you are a threat to her at this point in time. She will trust you again.

I think I have a bad broody. It is pouring rain out and she is out in the run sitting on her babies instead of being in the coop.

No this is a good mama hen. She got caught in the rain and will sacrifice her own comfort to keep her little ones dry and safe.

I have eggs due in the incubator about the same time mama will hatch. Can I give her extra chicks?

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Normally yes. It almost always is successful to do this while the hatch is going on. And within 2 or 3 days (max) of a completed hatch. Monitoring mama hen is a must. More often than not she will just accept them. Sometimes she will KILL them. Watch mama. Giving her the chicks while it is dark is best. Put them right under her. Wear gloves as you may get pecked - broody hens can draw blood.

Special Take away

We believe in the human-hands off approach to broody hens. There are of course times to intervene. A baby escaping from the pen is a common one. Give the baby back to mama and fix the fence.

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Until about a week old many chicks have trouble with ramps. Put on gloves and eye protection and help the babies in the coop. (Wear the gloves and eye protection as mama hen will most likely attack you.)

Baby got lost. It happens. Pick up the baby and return it to mama.

The "Should I intervene?" portion:

The best answer almost always is **NO!** Chickens survived thousands of years without human help and let us face it… chickens know how to be chickens better than humans know how to be chickens.

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Common "Should I?" questions:

"Should I help the chick out of the shell?"

My answer is "No." Here is my thought on it: If a chick is not strong enough to get itself out of the shell, it was not supposed to be born.

"My chick is shrink wrapped!"

There are ways to get the chick out, but here is what I have found from experience. When you do intervene and get the chick out, it often has either a crooked neck (which is permanent), or has a serious leg deformity. If mama kicked it out and it is shrink wrapped, she did it for a reason. Do not help. You cannot save every chick.

"My hen is kicking eggs out of the nest. Should I put them back?"

No. Hens know if an egg has quit, did not develop etc. Trust your hen and toss the egg.

Broody hens know what they are doing. Always trust your broody. 99% of the time they know exactly what they are doing. A broody hen is an amazing thing to watch. Sit back and enjoy the show. Only intervene if ABSOLUTELY necessary. This is truly a time where "mama knows best." Everything I learned about broody hens, I learned from my girls - just by observing them. At first I felt the need to intervene and quickly learned my first year with broody hens (10 broody hens that year as I recall) that mama knows best. The chicks I helped hatch were the first to die. The shrink wrapped chick I assisted was deformed and I had to cull it anyway. Mama knew best. Trust your broody. She really knows what to do.

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Artificial Incubation (Incubator Method)

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Introduction to Artificial Incubation

Artificial incubation of chicken eggs is nothing new. Since earliest history keeping there are accounts on how this was accomplished. From the earliest Egyptians as recorded by Aristotle in 400 BC. Those incubators were made of mud brick and look like enormous kilns. The exactness of the eggs temperature was tested by holding the egg to the eye lid. This skill is so precise it is still practiced and handed down through generations. These methods and kilns are still used to this day. I have read that hatch rate is very often 80%! Not bad. Not bad at all.

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Since mankind started domesticating poultry, it became apparent waiting for a broody to get in the mood was not going to supply enough eggs and chickens for a growing population year round. Incubation has gotten a bit easier for us in this day

and time. With so many more folks wanting to hatch just a few eggs or hundreds, electricity and finely calibrated thermometers and hygrometers helps a lot.

Types of Egg Incubators

Egg incubation is a process that helps promote embryonic development in birds, reptiles, and amphibians. This process is crucial for the survival of these species. There are two types of incubation: natural incubation and artificial incubation. Natural incubation makes use of broody birds while artificial incubation makes use of egg incubators. Egg incubators are devices used to hatch eggs by maintaining optimal temperature, humidity, and ventilation.

There are different types of egg incubators classified based on various factors such as the number of eggs that can be incubated at a time,

ventilation or airflow systems and mode of operation.

Types of Incubators Based on Airflow or Ventilation Systems

Developing embryos in eggs breathe in oxygen and breathe out carbon dioxide consecutively. Hence, an egg incubator requires a good airflow to constantly get rid of carbon dioxide as well as replenish oxygen. All incubators come with vent holes to take in the fresh air and remove the stale air inside them. Large incubators and some small incubators use an inbuilt fan to circulate air. On the other hand, some small incubators use natural ventilation. They depend solely on gravity to let warm, humid air escape through the top air vents while fresh air comes in through the bottom air vents.

According to airflow, there are two types of incubators which are:

- Still air incubators
- Forced air incubators

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Still-Air Incubators

This incubator type does not use fans but relies on gravity or natural draft to expel carbon dioxide and take in oxygen. Incubators under this classification

are also called gravity-ventilated or gravity-flow incubators.

One major drawback of still-air incubators is that ununiformed temperature through the device and humidity is less accurate.

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Forced air incubators

Forced air (also known as 'fan assisted') incubators come with in-built fans that pull out carbon dioxide and suck in oxygen. The fan also helps in circulating

warm air within the device and makes the temperature and humidity uniform and accurate. These are important to record a high hatch rate.

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Types of Incubators Based on stages

Single stage incubators

Single-stage incubation runs specific incubation programmes such that the climate in the incubator is programmed to match the specific needs of the developing embryos. Single-stage incubators can

also be cleaned after each incubation cycle and thus meet high hygienic standards of today's food production industry.

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Often, the transition from multi-stage to single-stage incubation is initiated by the replacement of aged multi-stage incubators by new single-stage equipment, without an awareness that hatchery management too will need to be adjusted. Management in a single-stage hatchery is certainly not based on a routine, but rather adjusted to accommodate the needs of a specific egg type. Consequently, hatchery managers need to learn about variation in needs of embryos from different egg types, as defined by strain, flock age and the duration of storage.

Advice

- Plan size of setters in accordance with size of batches of eggs. A batch of eggs is the total number of eggs produced on a specific day by one flock in one farm
- Create an overview of the egg types incubated in your hatchery
- Do not mix different batches of egg types. If separating egg types for incubation is not possible:
- Fill setters with batches of eggs that have similar characteristics with respect to strain, flock age and days of storage.
- Avoid filling one incubator with eggs from flocks more than five weeks apart in flock age.
- Avoid filling one incubator with eggs from one flock but with more than five days' storage difference.
- If the incubator has to be filled with more than one batch of eggs, do not combine fresh eggs with eggs stored for more than five days.
- Follow manufacturer's guidelines carefully when starting the first incubation cycle in the single-stage incubator.

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- Keep records for each incubation cycle, per egg type used and showing the different management steps taken per type.
- Use data with respect to hatchability, incubation time and chick quality from recording forms to fine-tune your incubation programmes.
- Train hatchery personnel so that they are fully advised regarding the different management steps required when using single-stage practices.
- Highlight the need for change: make sure hatchery personnel understand that single-stage management requires a different approach to multi-stage management to succeed.

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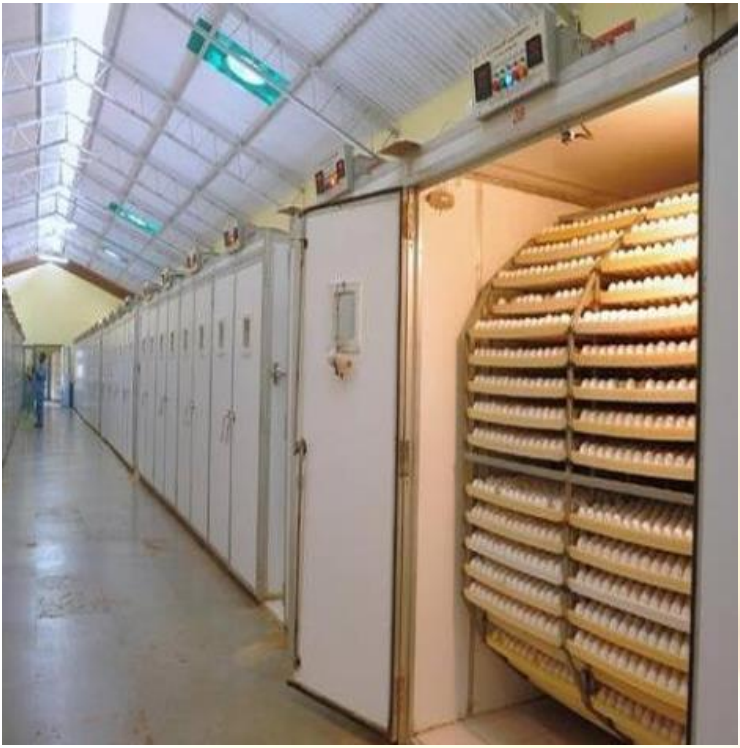
Multi stage incubators



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On the face of it, multi-stage incubation is an easy procedure. The setter is loaded with a new batch of eggs as the oldest batch in the setter reaches the point of needing to be transferred. A fully loaded machine contains eggs at all stages of incubation, and the average incubation age will be about 9 days.

At this stage in a single-stage incubation programme, the eggs do not produce a lot of heat and their oxygen demand is limited.

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Multistage incubation does not present great technological challenges. The setter can work at constant, fixed settings, aiming to create acceptable conditions for all batches. The trouble is that this 'average load' consists of batches that are in very different phases of incubation: from eggs that have just been loaded to eggs about to be transferred. The average set points might be close to the optimum for the middle groups, but they will be far from optimum for the extremes. And it is the extremes that determine the results. Too low a temperature at the beginning will cause an increase in early embryonic death. Overheating during the last days will lead to late mortality and poor chicken quality.

The eggs themselves offer a solution, however. Their opposing requirements can be utilised for mutual benefit. Fresh eggs are cool when loaded and need to be heated. Eggs containing advanced embryos must be cooled. Placing these two groups next to each other creates an opportunity for mutual heat exchange.

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Although all incubator manufacturers claim that their machines create a very uniform environment, breaking the laws of physics is not that easy. Differences in air speed, distance to the coolers, heaters, humidifiers and air inlets matter, and are reflected in egg shell temperature. Cooler and warmer zones can be defined in all types of equipment, and this can be made use of in a multistage system by placing the egg batches accordingly.

Temperature is of course not the only important parameter. Selection of the correct humidity setting, in line with the local egg shell quality, is critical for achieving 11-13 percent weight loss.

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Typically, the standard settings for a multistage incubator are: Temperature 99.5°F, Relative Humidity 50 percent, valve 50 percent (or Carbon dioxide 0.4 percent). The value of the parameters can vary quite widely, however. For example, optimum temperature can range from 99.0 to 99.9 °F.

So, how to select the optimum setting? The advice will depend on local measurements and observations, which must be carried out routinely: measuring egg shell temperature, calculating egg weight loss, and monitoring the machine's behaviour.

n a smoothly working incubator, internal devices will show low activity, the machine appearing to do nothing. Loading a new batch of eggs will activate heating, but this will stabilise again within a few hours.

Overheating presents a higher risk than slightly too low temperatures. Egg shell temperature between 99.4 and 99.7°F will slow down the process, while a temperature above 102.0°F poses a risk.

Advice

- Define the cooler and warmer parts of the setter, specific to the equipment type.
- Load the fresh eggs accordingly and place them next to the older eggs.
- Prewarm the eggs before loading (for at least 12 hours at 25-26 °C) to mitigate the resulting drop of temperature.
- Avoid egg shell temperatures below 99.0 °F and above 102.0 °F.

- Check egg weight loss to select the relative humidity setpoint.
- Select the maximum valve position within the 30-60 percent range at which the machine remains stable. Opening too wide activates the humidifiers, which is undesirable, and opening too little can cause too high carbon dioxide (CO_2) levels.

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Types of Incubators Based on size or Capacity

Small or mini incubators

Small incubators are a type of egg incubator designed to hatch a small number of eggs (usually less than 50 eggs) at a time. Small egg incubators are a necessity for those who wish to hatch chicken eggs or other poultry eggs on a small scale.

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Small incubators are sometimes referred to as *tabletop* incubators or *mini* incubators. They are also useful for educators who wish to use them in the classroom to teach about the process of incubation and hatching birds' eggs.

Medium incubators

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Medium incubators are designed to hatch a medium range of chicken eggs (generally 50-200 eggs at one time). A medium incubator is the most ideal for those with a medium-sized flock, or for those who wish to hatch a larger amount of eggs on a smaller budget than a large incubator.

Large or industrial incubators

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Large incubators are designed to hatch large numbers of chicken eggs (usually more than 200 eggs at one time). A large or industrial incubator is generally the most suitable for big breeders or farms with a lot of fertile eggs to hatch. An industrial incubator can accommodate up to 5000 eggs at a go.

Types of Incubators Based on mode of operation

Egg incubators are also classified according to their mode of operations or how they carry out vital operations. The types of incubators based on operating mode are:

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- Manual incubators
- Semi-automatic incubators
- Automatic incubators

Manual Incubators

As the name suggests, the manual incubator is an incubator that the user has to manually do everything from turning the eggs to managing the temperature and humidity.

Semi-Automatic Incubators

In semi-automatic incubators, the user does not have to turn the eggs manually. There is a

motorized system in place for this. However, the user will still have to monitor and control the temperature and humidity manually.

Automatic Incubators

Automatic incubators are the most advanced type. They come with pre-programmed settings for temperature and humidity. The user only has to load the eggs and the incubator will take care of the rest.

Getting Started with Egg Incubator

A farmer needs to become acquainted with the incubator before starting incubation. Incubators may or may not have internal fans to circulate the air, and the two types operate at slightly different temperatures. A small wood and glass incubator works fine for the later periods of the incubation and hatching process so long as reasonable care is provided in tending the incubator and eggs.

Polystyrene and metal desktop incubators work reasonably well if manufacturer's instructions are followed.

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Location

Choose a location for the incubator that is free from drafts, out of direct sunlight and not too close to heating ducts and radiators. A sturdy table on which to place the incubator as well as access to an electrical outlet will be needed.

Sanitation

Sanitation is very important. Before setting any eggs, clean the incubator. It is essential that the incubator and related equipment be cleaned thoroughly between hatches. This may be done by wiping, sweeping or vacuuming. Heavily soiled areas such as the wire rack on which the eggs were placed may require thorough washing and scrubbing to remove heavy soil.

Before working inside the incubator, be certain to disconnect its electrical cord from the outlet to avoid possible electrical shock. A dilute solution of household bleach and water (20 drops of bleach per quart of water) makes an inexpensive cleaning and disinfecting agent. Take care not to introduce moisture or water into the electrical system of the incubator and allow all surfaces to dry before again reconnecting the electrical cord to the outlet.

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Calibration

It is important that an incubator be calibrated for temperature and humidity control. Allow several hours preferably overnight for temperature and humidity inside the incubator to reach equilibrium.

Temperature

With a properly functioning unit, there will be a regular cycle of temperature fluctuations. A poultry breeder should try to maintain an average within

the recommended range. If the average temperature is too high or too low, adjust the thermostat accordingly. In the still-air incubator, one without a circulating fan, adjust the wafer thermostat to maintain an average incubation temperature of 100 to 102 degrees Fahrenheit dry-bulb temperature, with an acceptable range from 97 to 102 degrees Fahrenheit. The target for forced-air incubators is usually 99.5^0F. The temperature control wafer expands with increasing temperature and shrinks as it cools. A defective snap switch or a leaky wafer will make the temperature control malfunction. New very precise temperature control designs are becoming available, but these also need checking for accuracy.

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Humidity

Relative humidity is calculated by using a wet-bulb thermometer to measure the temperature inside the

incubator. A web bulb thermometer has a dampened wick covering the bulb. A wet-bulb temperature of 88 degrees Fahrenheit and a dry-bulb temperature of 101 degrees Fahrenheit converts to 60 percent relative humidity. This is a good starting humidity.

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If the humidity is too low (high wet-bulb temperature) then the size of the evaporation pan must be increased. This can be done either by increasing the size of the pan or by placing a small sponge in the water so that at least half of its surface is still exposed to the air. If the humidity is too high (low wet-bulb temperature), then the size of the pan must be decreased or water surface area reduced.

After a chick has hatched, the effectiveness of humidity control can be assessed by examining the location in which the chick pips, pecks through the

shell. Ideally about one-third of the shell is removed as the chick hatches.

Incubator Reminders
• Place the incubator in a room with a constant temperature, no drafts or direct sunlight. • Sanitize the incubator. • Wash hands before touching eggs. Keep germs, dirt and oil away from incubating eggs. • Only incubate eggs together from species with similar incubation periods. • Keep the small end of the egg lower than the large end. • Record of incubator data daily. • Ensure that the humidifier is working or that the water pan is filled. • Verify humidity levels are between 55 to 60 percent. • Check temperature daily and keep it at 99.5°F to 100°F. • Turn eggs at least 5 times a day until 3 days before hatch. • Increase ventilation during the last third of incubation. • Do not turn for the final 3 days. Provide a cloth or rough paper for the chicks to walk on. • Increase humidity to 65 to 70 percent at hatch stage.

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Selecting Eggs for Hatching

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Eggs laid by the hens without mating the cock will not hatch out, as they are infertile without any germ inside to develop into a chick. By rapid development and transformation within an egg, a minute germ can be converted into a chick in 21 days. All of a hen's eggs are unfit for hatching. Suitable eggs for hatching should be carefully picked on the following criteria.

- **Fertility.** Fresh eggs collected from healthy and well-matured hens between 5- 7 days after

mating and within 2 days of separating the cock will be fertile enough to hatch. Eggs taken quickly after letting in the cock for mating or long after the cock has been separated may not be fertile.

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- **Egg size and shape**. The size of the eggs used for hatching is important since the size of the hatched chick is strongly dependent on the size of the egg. Depending on the breed, the eggs for setting should be neither too large nor too small. It is always preferable to choose eggs weighing about 58 g each. Eggs that are uniform in size and shape are preferable.
- **Choose eggs bred with the right compatibility.** Make sure the batch of eggs being chosen from were bred from unrelated parents. Make sure they are never inbred, such as mating a brother and sister, daughter and father, or son and mother. This usually

predisposes the chicks to abnormalities, diseases, and deformities.

- **Egg shell.** The eggshell should be equal in thickness, texture, and color so that warmth can spread uniformly throughout incubation. In the case of white-shelled eggs, all eggs for incubation should be tint-free. Medium and dark brown eggs hatch faster than light brown eggs when it comes to brown eggs. Low hatchability occurs when the shell texture is poor due to a calcium or vitamin D deficit. All eggs should be checked for cracked shells before being utilized for incubation.
- **Egg quality:** Eggs should be gathered as soon as possible after laying, preferably within a week of lying, to ensure that they are fresh and not stale. Fresh eggs laid on the day of setting should not be set unless they have reached room

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temperature before being set. Eggs that are 2 to 4 days old are ideal.

- **Deformity.** Eggs with ridges, encrustations, projections, depressions, cracks, or stains should not be chosen. Very thin shells may break during rotating and fail to maintain a consistent temperature for the embryo's development. If the shell is too thick, the chick will struggle to chip it with its fragile beak and escape.
- **Soiled eggs.** Soiled eggs should not be washed in water before setting since doing so opens up the pores and interferes with the hatching process. If the dirt is not too thick, it should be removed with a knife. Eggs that have been heavily stained should not be utilized.
- **Storage.** To achieve the best results, eggs collected for setting should be kept in a dry, cold, and airy environment. Eggs should not be

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kept for more than three days in hot temperatures, although they can be maintained for up to ten days in cold weather or on hillsides.

As eggs absorb odor very easily, it is not good to store them near smelly substances like onion, garlic, kerosene, etc. Eggs should be stored in a cool place with the broad ends up. Eggs shaken very much during transport will not be good for hatching.

Farmers' Frequently Asked Questions Answered

What happens to a hen when her eggs are taken for artificial hatching? Does that frustrate her?

When a hen's eggs are taken away for artificial hatching, it can have both positive and negative effects on her. On one hand, she may experience frustration and a sense of loss as she is separated from her chicks. This is because hens are maternal creatures and have a strong instinct to protect their young.

When eggs are removed from a hen's nest, she may show signs of distress such as vocalizations, pacing, or loss of appetite. These behaviours can indicate that she is experiencing emotional distress. The hen may also become aggressive or protective around the nest area, as she is trying to protect her eggs and any potential intruders.

On the other hand, artificial hatching can provide benefits to both the hen and the chicks. It allows the eggs to be incubated in a controlled environment, which can improve chances of successful hatching. Additionally, it

allows eggs to be hatched outside of breeding season, enabling the hen to focus on producing more eggs.

Overall, the removal of eggs from hens for artificial hatching can be an emotional experience for them. However, it can also provide positive outcomes for both the hen and the chicks involved. It is important to consider the hen's well-being and provide appropriate care and attention during the process.

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Incubator Set-up

It is a good idea to wrap the cheaper, Styrofoam-type incubators in some sort of insulating material. A blanket will work, or a box lined with insulation. These incubators can be sensitive to temperature changes in the room they are in, so if it is possible, set them up in an interior room where there is no direct sunlight. If the house temperature changes throughout the day in the winter, it is a good idea to set up a small, temperature-sensitive heater to try to keep the incubator room at a steady temperature. Get the incubator set to the proper temperature at least 3 days before setting the eggs.

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Use a digital, human grade thermometer for best results. If a farmer wishes to use a good quality digital thermometer that will stay inside the incubator, he/she should be sure to get TWO. Thermometers can be off a bit and if a variance between the two thermometers is noticed, a third thermometer should be got to be sure. Place a record sheet near the incubator for daily note taking. Records are helpful to keep track of the days of incubation, time eggs are turned, incubator temperature, weight of eggs set, and other notes.

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The vent plugs should be pulled out of the incubator because they will not be used for this hatch. The temperature should be set where the farmer thinks it will be right, and leave it alone for 24 hours. If a farmer is using a digital thermometer made for taking human body temperature, he/she should wrap it in whatever he/she has on hand

(fabric, toilet paper, whatever) to allow the thermometer to fit in the hole and sit there comfortably, with the hole plugged by the wrapping material.

The bulb of the thermometer should be put anywhere from the bottom of the fan to about where the middle of an egg would be to get the most accurate reading. (With circulated air, the temperature should be pretty close to the same throughout the incubator, but that is a good area to test. Be sure the thermometer(s) are far enough from a heating element to prevent incorrect readings when testing the temps.)

The cheap digital thermometers a farmer can get anywhere are just that. They are cheap and can be unreliable. A lab grade thermometer can be verified/calibrated two ways (and we recommend using both). First, put it in a cup of ice water,

stirring the water constantly. It should read 0^0C or 32^0F. Second, put it in a pot of water and bring it to a boil, again stirring constantly so the water does not get hot spots. It should boil at 100^0C or 212^0F.

Whatever thermometer a farmer has, he/she should learn how it works and how long its recording cycle (if digital) is. Be aware if it only goes up to the high stable temp or if it shows variable temps, etc. Then put it in the incubator (through the vent hole so it can be read easily) and start watching it. Write down the temperature it is reading (once it's been in there maybe 10 minutes) when the heating element comes on. Time the heat cycle (does not have to be exact but helps to know how long it's cycling) and take another reading when the element goes back off. Again, time how long the element is off... ideally it should be on for a shorter time than it's off. Figure out, over 5 or 6

cycles, if the incubator temperature stays pretty consistent. the highest and lowest temps you record will actually be AFTER the heating element turns off and on, since it's got enough thermal mass to continue heating slightly even after it turns off, and the coolest will be after the thermostat turns it back on, again because it takes a second to start building up more heat...

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Taking a number of readings will tell a farmer roughly what the temperature range will be. If it is high or low overall from 99.5 (average temperature) then the farmer needs to adjust the incubator. (A LITTLE AT A TIME!) Do not do more than a quarter turn on the adjuster at a time, and not more than once every 5 or 6 hours at least.

Once the farmer has got the incubator set well, he/she should use the lock nut (a second wing nut

at the bottom of the stem against the incubator) to lock it down so it does not turn accidentally. Then test the temperatures again, in case the incubator was moved. (Not all incubators have this locking feature.) Run it for a good 24-48 hours and just check periodically to make sure it is in the right range each time.

Setting Eggs

Once the incubator is set-up and have analyzed the settings to ensure accuracy, the farmer is ready to place the eggs inside the incubator. This process is called "**setting the eggs**."

Plan to set a minimum of six eggs at one time. Setting fewer eggs, especially if the eggs were shipped, often results in one or no hatchlings. The number of chicks that hatch together is especially important for the newborn chicks because chickens are flock animals and need companions to be

happy. Place the eggs in the egg tray of the incubator, with the larger end facing up and the narrow end facing down in the incubator. Set the temperature to 100.5 degrees Fahrenheit with 50-55 percent humidity.

Before handling the eggs, the person going to pick them should also wash his/her hands and anything the eggs will come into contact with. Incubators are a great environment for growth of harmful bacteria and other germs. Good sanitation is important in obtaining a good hatch.

To avoid excessive thermal shock to the eggs, allow them to warm to room temperature before placing them in the incubator. In incubators without turning devices, place incubating eggs either on their side or with the small end down.

Never cool eggs again after starting incubation. Cooling can occur at temperatures below 80

degrees. In case of a power outage, small incubators may be covered with a blanket to conserve heat for short periods.

For hatches of small groups of eggs, use a pencil to mark on the side of each egg the date on which the eggs are set. Then holding the pencil against the shell at the date mark, rotate the egg half a turn, drawing a line to the opposite side. Mark an X on the shell at the end of the line opposite the date mark. By marking the egg in this way, one will be able to keep track of the direction and rate of turning.

When placing the eggs in incubators without egg-turning devices, lay eggs on their side and space them as evenly as possible allowing room for turning.

Do not place the egg with the small end above the large end. If the incubator has a mechanical egg-

turning device, set the eggs according to the manufacturer's instructions. This is usually with the large end up.

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Do not allow the eggs to touch the side of the incubator or get too close to the heat source, which will cause uneven heating and lead to a poor hatch.

Managing the Incubation Process

During incubation, eggs found to be leaking, cracked, or moldy should be removed and disposed off. Such eggs may explode because of high microbial populations. The released odor is very offensive and would require expedient removal of all the eggs.

The normal incubation time of most chickens is 21 days to 21 days, 6 hours. Incubation time may vary according to weather and incubator, size of egg,

fertility of egg and vigor of the embryo, and a host of other factors.

Several factors affecting the duration and success of incubation are within the breeder's control. There are important considerations to keep in mind during incubation and these are temperature, humidity, ventilation, incubation period, position of eggs and turning, setters and hatchers, testing of eggs (candling).

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The aforementioned factors are further explained as below:

Temperature

Temperature is probably the most important single factor influencing the development of the embryo. Near the optimum incubation temperature ranges, a higher temperature will advance the hatch and a lower temperature will delay hatch. A one-half-degree change in average incubation temperature

will move the average hatch time by about 5.4 hours.

To monitor the temperature, place a calibrated and accurate thermometer 1 inch above the wire mesh screen on which the eggs sit. This location corresponds approximately to the top of the eggs, where the temperature should be measured.

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Temperature too high. Younger embryos are especially susceptible to high temperatures because the upper lethal limit is very close to the optimum incubating temperature. Operating the incubator at 105 degrees Fahrenheit for 30 minutes will seriously affect, if not kill, the embryos. High temperature will lead to nervous problems, heart and circulatory problems, and kidney problems and will cause the embryonic membranes to dry out too soon. Chicks that hatch may have clubbed, wiry down and unsteady gait.

Temperature too low. Slightly low temperatures for short periods will have a less severe effect on the embryo than high temperatures. Subnormal temperatures lower the metabolism of the embryo, slowing its growth until the temperature returns to normal. Low temperature for short periods leads to disproportionate growth, because organs and tissues respond differently to temperature variation. Low temperature can also cause heart and circulatory problems, reduce membrane growth and nutrient uptake by the embryo, and cause slower growth after hatching. Older embryos are more susceptible to low temperature.

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Humidity

Proper humidity is important because it keeps the egg from losing too much or too little moisture during the incubation process. Eggs should lose between 11 and 14 percent of their weight from day

1 to day 18 of incubation. This weight loss is a direct indicator of humidity control.

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Humidity should be balanced with temperature; different temperatures require different relative humidities. Relative humidity should be 60 to 65 percent for the first 18 days of incubation, and 70 percent for the last three days. The water pan in the incubator should be kept full at all times. Use warm water to fill the pan. Humidity adjustments are made as discussed above in the calibration section.

Opening the incubator to turn the eggs will cause a loss of humidity. In very dry environmental conditions, sprinkle the eggs with a little warm water after turning them. The rate of dehydration can be determined by using a flashlight or slide projector to candle, or shine through, an egg so that the contents can be examined. If the air cell is too large, the humidity must be increased. Low

humidity can cause the chick to stick to the shell and membranes at hatching. If the air cell is too small, the humidity must be decreased. Excessive humidity will weaken the chick to the point that it cannot emerge from the shell at hatching.

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From day 19 on, condensation on top of the incubator indicates adequate humidity is present. The amount of condensation varies depending on the temperature of the room where the incubator is located.

It is best not to open or move the incubator during the last three days of incubation for more time than it takes to add water to the pan.

Ventilation

The embryo is a living tissue and as such needs to exchange oxygen and carbon dioxide throughout the growth process. The amount of air exchange

needed increases as the embryo develops. As the embryo develops, it uses oxygen and gives off carbon dioxide. Thus, sufficient ventilation within the incubator is required to assure an adequate supply of oxygen and proper removal of carbon dioxide.

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The optimum concentration of oxygen is 21%. Oxygen concentration above or below 21% negatively affects hatchability. Likewise, the carbon dioxide concentration should not exceed more than 0.5%. Proper ventilation is maintained with the help of fans fitted to the rear side of the incubator.

The vents which are located above and below the eggs should be opened gradually until they are fully opened during the final three days of incubation.

Ventilation rates that are too low prevent normal moisture evaporation and cause large weak chicks

or death. High ventilation rates remove too much moisture and can cause the shell to stick to the chick, making hatching difficult. 1000 eggs require 143ft^3 of fresh air per day (oxygen in the air at 21%) on the 18th day of incubation.

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Hatchability will drop about 5% for each 1% drop of oxygen content in the air below 21%. Gaseous exchange rate during incubation varies with the age of the embryo.

Incubation Period

The phrase incubation period designates the time from the commencement of incubation to hatching.

One of the miracles of nature is the transformation of the egg into the chick.

Not every avian eggs hatch in 21 days. See the table below for incubation periods for different avian

species. Never incubate the eggs of wild birds; these chicks will not live without their mother's care if they do hatch.

Incubation Periods (species and days required to hatch)

Species	Days Required to Hatch
Pigeon	16-18 Days
Pea Fowl	28 Days
Chicken	21 Days
Turkey	28 Days
Pheasant	24-26 Days
Goose	28-33 Days
Guinea	26-28 Days
Muscovy duck	35-37 Days
Duck	28 Days
Ostrich	42 Days
Bobwhite Quail	23-24 Days
Swan	35 Days
Dove	14 Days
Parrots	28 Days
Crane	30 Days

Position of Eggs and Turning

After setting the eggs, the incubation process begins. An important part of this process is turning or rotating the eggs.

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It is believed that turning the egg prevents adhesion of the embryonic membranes, facilitates movement of the embryo into the normal hatching position (thereby reducing abnormalities and malposition), stimulates the growth of the membranes, and increases the heart rate. The increased heart rate and membrane growth facilitate absorption of the nutrients from the yolk, albumen, and shell, and improves gaseous exchange.

It is necessary to turn the eggs at least three times a day to ensure that the embryo remains close to the center of the egg and does not stick to the shell membranes. Turn the eggs the first thing in the morning and the last thing in the evening and at

least one or two times in between. Turning the eggs an odd number of times (5, 7, 9) each day is recommended. Avoid rotating the egg in a full circle, which can cause the embryo and egg components to become tangled and twisted.

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Turning should be done through day 17 of incubation, after which the chick is positioning itself for the hatching process. The most important period is from day 1 through day 12, when the chorion and allantois are developing and eventually fuse, forming the chorioallantois. During this time the most critical period is from day 3 through day 7, when the circulatory system is developing and beginning to function. Researchers have found that turning is not necessary past as early as day 14 of chicken egg incubation, although most systems continue to turn the egg through days 17 to 19.

Key Takeaway

Be sure to wash hands or wear clean gloves before touching the eggs to prevent the transfer of skin oils or germs to the developing chick.

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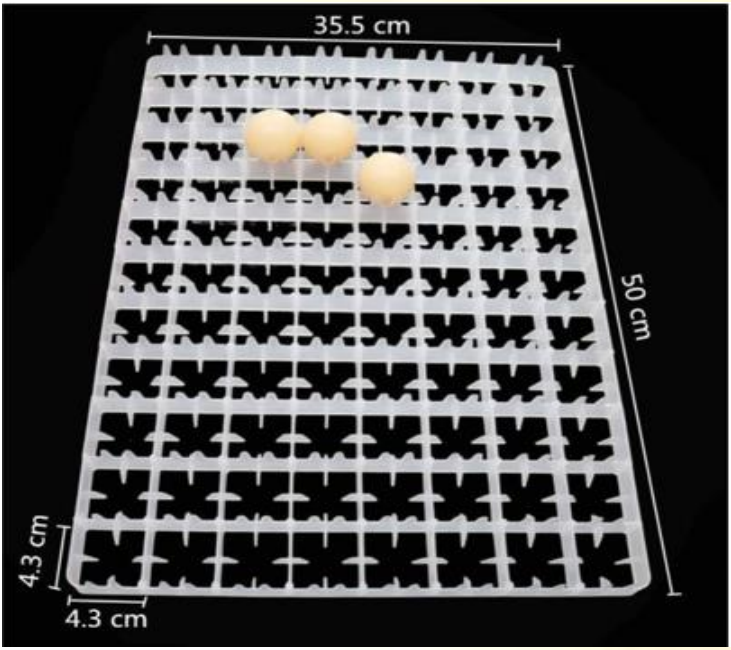
Setters and Hatchers

Two separate machines are used during the incubation process.

Setters



Chicken eggs require to be turned from time to time; hence the importance of an egg setter. When eggs are placed in the setter, the setter turns them automatically every hour for 18 days before they are moved to the hatcher. The eggs only spend between 3 and 4 days in the hatcher at a different temperature and humidity, usually higher than the temperature in the setter.

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Hatchers

On day 18, eggs have to be transferred from the setters to the hatchers. The hatchers will have a lot of heating. Hatcher and hatcher baskets always should be dry before they are used. As soon as the eggs are in it from day 18 to 21, the hatcher will mainly cool down because the developing chicks produce the most amount of heat. In this stage, it is crucial to avoid risks of overheating or overcooling else, it may result in **head over wing**

malposition which results even when there is uneven cooling process due to lack of air flow.

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Candling and Assessing Egg Development

Egg candling is a process commonly used in commercial hatcheries to assess the fertility and development of eggs, particularly during the incubation period. It involves shining a light source, typically a bright and focused beam of light, through an eggshell to observe the internal contents of the egg. This illumination allows hatchery workers to visually inspect the egg's contents, which can reveal important information about the egg's viability, such as the presence of a developing

embryo, signs of early mortality, or infertility. Infertile eggs and those with deceased embryos, are collectively referred to as 'clears'. Initially, this inspection can occur as early as day 5 or 6 of incubation, where an individual light is used to illuminate the eggs. However, this method is time-consuming and carries the risk of errors, such as accidentally removing a viable egg.

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The potential for candling errors can be minimized by conducting the examination on day 9 or 10 of incubation. At this point, an alternative approach known as a 'candling table' can be employed. This involves illuminating the entire tray of eggs from beneath. While using a candling table is quicker than individual egg inspection, it may sacrifice a degree of accuracy. This is particularly evident when there is a high number of 'clears', as light passing through empty spaces in the tray can make

it challenging to definitively identify remaining clear eggs. Many hatcheries opt to candle eggs on the day they are transferred from the incubators to the hatchers, as this proves to be the most efficient in terms of time and labor. When eggs are examined in this manner, automatic candling equipment can be utilized, which illuminates all eggs before any clears are eliminated. This approach avoids the drawback of reduced accuracy caused by light flooding.

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The primary purposes of egg candling in commercial hatcheries include:

- Fertility Assessment: Candling helps identify infertile eggs that do not contain developing embryos. These infertile eggs will not hatch and can be removed from the incubation process, preventing unnecessary incubation resources from being used.

- Early Mortality Detection: Eggs with embryos that have died at an early stage can be identified and removed. This prevents the potential for contamination from decomposing embryos and allows the hatchery to allocate resources more effectively to viable eggs.
- Early identification of issues on breeder farms, during egg handling, and throughout incubation, especially when combined with egg break-out analysis.
- Hatchery Efficiency: By identifying non-viable eggs early on, hatcheries can optimize the use of incubator space, reduce the risk of contamination, and improve overall hatchery efficiency.
- Chick Quality: Candling can help improve the quality of hatched chicks. Removing non-viable eggs and identifying potential issues can contribute to higher hatch rates and healthier

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chicks. It also helps to estimate the expected percentage of viable chicks. Clear eggs introduced to the hatcher baskets create an unstable environment as they do not generate metabolic heat. When automatic chick separators are used, there is a risk of clear eggs breaking and leading to 'painted' chicks.

- Data Collection and Analysis: Hatcheries can gather data on hatch rates, fertility rates, and other important metrics by tracking candling and break-out results over time. This information is valuable for evaluating hatchery performance and making necessary adjustments.
- Waste Reduction: Removing non-viable eggs reduces waste and the need for disposal. In some cases, clear or infertile eggs may have alternative uses, such as for pet food or other products.

Egg candling is typically performed at various points during the incubation process, such as around day 5-6, day 9-10, and sometimes closer to the day of transfer to the hatcher. The timing of candling can affect its accuracy and the information it provides. As mentioned earlier, more advanced techniques such as using candling tables (illuminating entire trays of eggs) or automatic candling equipment have been developed to improve efficiency and accuracy.

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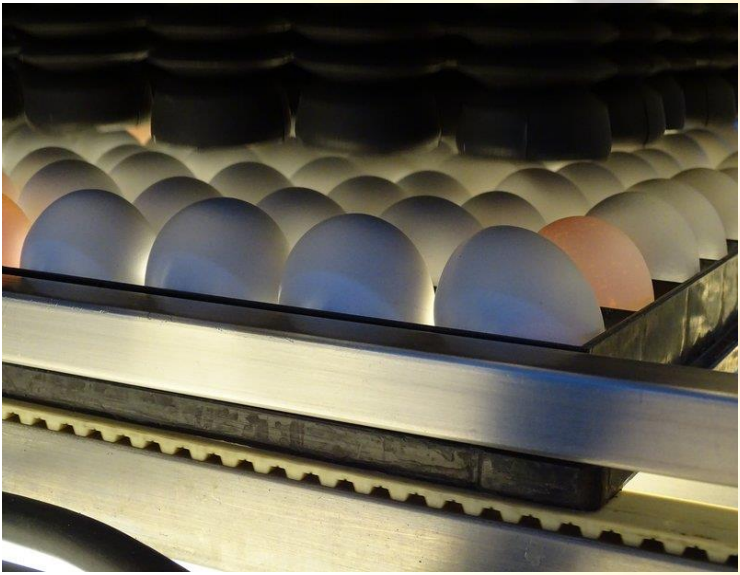

Below we have listed some extra guidelines for the hatching egg candling process:

- Avoid candling of hatching eggs between days 11 and 14 of incubation, as this disrupts embryo movement along the egg's length axis.
- When candling hatching eggs on day 9 or 10, fill empty spaces on the setter tray by shifting remaining eggs backward to create complete rows, leaving the front rows empty.
- Remove clear eggs if they exceed 10-15% of the total. If the clear percentage is under 10%, there's no immediate need for removal before transfer.
- If more than 30 eggs are removed during candling on the day of transfer from a tray containing 150 eggs, add eggs from another tray to ensure hatcher baskets are adequately filled. Ideally, eggs should touch each other within the basket, as vibrations caused by the first chicks

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pipping can stimulate other chicks to start hatching.

In summary, egg candling is a critical practice in commercial hatcheries to ensure the highest possible hatch rates, optimize hatchery operations, and produce healthy chicks for the poultry industry.

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Preparing for the Hatch

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By day 18, the embryo has developed into a chick and will take up most of the space in the egg. The chick is preparing to hatch. A few things can be done to best help the baby chick prepare:

- Stop egg-turning at day 18 with the larger end of the egg facing up. At this point, the chick will position itself for hatching inside the egg.
- Approximately three to four days before hatching is a good time to remove eggs that appear to be infertile or contain dead embryos.

Check the eggs by candling, and handle the nonhatching eggs carefully.

- It may be helpful to place several layers of cheesecloth over the wire mesh on the bottom of the incubator four days before hatch. This provides a smooth surface to help keep the chicks from injuring their navels or getting their legs caught in the mesh. This also helps keep the incubator clean and the shells out of the water pan.
- Maintain a temperature of 100.5 degrees Fahrenheit but increase humidity to 70 percent.
- The hatching process releases much fluffy debris inside the incubator. Care should be taken not to open the incubator in drafts and to carefully remove shells and debris. Wearing gloves and a face mask may help to provide better hygiene while doing this cleanup.

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When Eggs Fail to Hatch

Approximately two out of every 10 eggs normally do not hatch. The majority of this expected embryo mortality occurs during the first and last weeks of incubation. Mortality during the last three days of incubation may be the result of an accumulation of factors that weaken chicks to the point that they cannot survive the normal rigors of the hatching process.

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Other causes of mortalilty can be related to inappropriate management or function of the incubation process. Common causes of abnormal mortality levels during the first and second weeks of incubation include improper temperature or ventilation. Incubator overheating, for example, can quickly kill the developing embryo. Early in the incubation period, overheating can also contribute to the incidence of exposed viscera (yolk sac and

internal organs protruding from body cavity) in the nearly fully developed chick. Overheating, together with rough handling of the eggs, can contribute to malformed head parts, such as a protruding brain, deformed beak or lack of eyes.

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Improper temperature or ventilation can also cause death during the pipping stage as chicks peck through their shells. Other possible causes of death at this late stage of development include improper humidity control, disease and even thin egg shells.

Diagnosis of failure to Hatch

A breeder/farmer may be able to learn why some eggs failed to hatch by breaking and examining them for certain diagnostic signs based on the appearance and comparative development of the egg and embryo. Note that this procedure can be dirty and produce unpleasant smells, so care should be taken. Break the egg into a flat container, such

as an old plate, and evaluate the contents according to the following criteria:

- **Clears:** Absence of a blood ring or embryo development indicates that either the embryos died early in incubation or the eggs were infertile.
- **Blood rings:** Clear eggs with a formed blood ring or small embryo indicate that death occurred in the first three days of incubation. Possible causes are incubator malfunction during days 1 to 3 or improper storage of the eggs before setting.
- **Dead early or midterm embryos:** Many factors can cause embryos to die early or in midterm. Possible causes include excessively high or low incubation temperatures, improper turning, low viability of the egg caused by parental nutrition or inheritance, improper ventilation and suffocation, disease, poor egg

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shell, and contamination. Embryos subjected to overheating will appear red because of hemorrhaging of blood vessels.

- **Fully formed and not pipped:** When chicks die fully formed without pipping, the usual causes include low average incubation temperature, weak viability of setting eggs, improper humidity, genetic defects, contamination or temperature malfunction.
- **Malformed chicks:** Genetic and chance deformities may occur. High temperature during certain formation times may lead to deformities. Rough handling of incubating eggs may contribute to malformations.
- **Cull chicks:** Dry chicks with egg shells sticking to their down may indicate low humidity after pipping starts. Chicks hatching earlier than usual with bloody navels or navels not healed properly might indicate too high temperature or too wide

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temperature swing during incubation. Chicks hatching later than 24 hours after the start of hatch are commonly cull chicks that will not grow well and will be more susceptible to stress and disease challenges. Prolonged hatches typically result from poor egg vigor or an unbalanced environment throughout the incubation period, not just at the time of hatch.

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Weak chicks may be placed in special isolation housing for their protection. However, chicks will be more settled if they are placed with other chicks. Some methods to terminate incubating eggs include placing the eggs in a container filled with carbon dioxide or in a low-temperature environment.

Early Chick Care

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Newly hatched chicks are wet and easily chilled as this moisture evaporates. Chicks should be removed from the incubator when they have dried and the down becomes fluffed. This drying normally takes about 12 hours. The chick also rests following its efforts to cut and exit the egg shell. Avoid frequent opening of the incubator to remove

hatching chicks, because this will cause problems related to chilling and loss of humidity for the remaining eggs in the setting.

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The newly hatched chick is unable to maintain or regulate its body temperature. The ability to regulate body temperature increases during the first three weeks of the chick's life. The body temperature of a very young chick is below that of the mature fowl. This difference disappears at about three weeks of age. By this time the chick's feathering, metabolism rate, and ratio of surface

area to body mass allow the bird to accommodate to a lower environmental temperature. Minimum room temperature is 75 to 80 degrees Fahrenheit for holding the chicks.

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Keep the chicks together. A chick placed by itself usually becomes distressed and will cheep loudly for the other chicks. They are best maintained as a flock.

Chicks should be kept in a draft-free area with plenty of nonstale air for them to breathe. A thousand chicks have about the same oxygen demand as one adult human.

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Chicks will get a good start if they drink and eat within a few hours after removal from the incubator. The yolk sac they absorb just before hatching can supplement early food needs. If chicks are offered food, they will normally begin eating soon after they are hatched, dried, warm and rested. Bread crumbs, oatmeal, or hard-boiled eggs can serve as temporary diets for the chicks during the first day or two, but a complete commercial diet is recommended.

Farmers' Frequently Asked Questions

What is an incubator?

An incubator is a machine which provides an artificial way of keeping eggs at the right temperature and humidity until they hatch. There are several different types, from the home made to manual, semi-automatic and fully automated.

BROODING

At the end of this section, the following topics should have been discussed:

- Introduction to Brooding
- Types of Brooding in Poultry Farming
- Brooder Setup and Equipment
- Brooding Environment
- Brooding Management
- Gradual Transition to the Outdoors
- Troubleshooting Common Brooding Issues
- Recording Keeping and Evaluation
- Sustainable Practices in Poultry Incubation and Brooding.

Introduction

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The proper brooding of chickens is one of the most difficult operations on poultry farms, especially for the beginner. Many poultry keepers who are able to get good egg yields and fair hatches make a failure of brooding chickens, either raising only a small percentage of the chickens hatched or failing to rear strong, vigorous birds which develop into good breeding stock.

Methods of artificial brooding are being improved each year, but no one system has given perfect satisfaction.

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Brooding with hens is the simplest and easiest way to raise a few chickens and is the method which is used almost exclusively on the average farm. Artificial brooders are necessary where winter or very early spring chickens are raised, or where early leghorns or either non-sitting breeds of poultry are kept. They are necessary also where large numbers of chickens are raised commercially.

Successful natural rearing of chickens requires convenient facilities and regular attention. Although artificial methods require a larger investment, closer attention, and more care, they are more commonly used where large numbers of chickens are raised.

What is brooding in Poultry Production?

Brooding is defined as the management of chicks from one day old to about 8 weeks of age, and it involves the provision of heat and other necessary care during chicks' early growing period.

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Brooding units are designed to house chicks from one day old until they no longer need supplementary heat (0-8 weeks).

Types of Brooding in Poultry Farming

Brooding in poultry can be natural or artificial

- Natural Brooding

- Artificial Brooding

Natural Brooding – By Broody Hen

Natural brooding is when mama hen takes care of her own chicks. Mama hen will keep her chicks warm with her own body heat and teach them how to scratch for food. Natural brooding is truly special experience to watch, and much easier for a poultry farmer since mama hen takes care of everything,

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The natural method of brooding is used on farms where only a few chickens are raised each year. Depending on her size, a hen will brood 15-20 chickens. The broody hen will provide all the warmth required by the chicks, right after hatching up to about 3 or 4 weeks of age. Before placing the chicks with the hen she would be examined for her

good health and free from lice, ticks and other ectoparasites.

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Artificial Brooding – By Artificial Ways

Artificial brooding can be defined as the handling of newly born chicks without the aid of hens. It is accomplished by means of a temperature-controlled brooder (foster mother). Artificial brooding has several advantages over the natural method, which are:

- Chicks may be reared at any time of the season.
- Thousands of chicks may be brooded by a single person.
- Sanitary conditions may be controlled.

- The temperature may be regulated.
- Feeding may be undertaken according to the plan.

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Brooder Setup and Equipment

Establish the brooder in a room or barn that is protected from the elements, free of drafts, and safe from predators. In addition to larger, more obvious predators (such as dogs and cats) secure the brooder from smaller predators such as rats and snakes.

The brooder must be kept uniformly warm. The temperature at the floor needs to be maintained at 90°F or slightly higher, and temperature under the brooder at 95°F 2 to 3 inches from the floor.

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Provide ventilation, allowing fresh air to circulate in the brooding area, but protect the chicks from drafts.

The size of the brooder will depend on the number of chicks to be raised at a given time.

It should be round. If the brooder is square, round out the corners by adding semicircular pieces of material (cardboard, wood, or sheet metal) secured in each corner. This reduces the likelihood of

chicks piling into corners and suffocating the birds at the bottom.

If the brooder has been used before, disinfect it before introducing a new flock. Several weeks before any chicks arrive, the building, brooder, and other equipment associated with the chicks should be thoroughly cleaned and disinfected to prevent any contamination from pathogens that may be present from previous flocks, other livestock or wildlife.

The floor should have a small thin of layer. Bedding in the brooder needs to provide an absorbent, non-slippery surface for the young chicks. Most producers use readily available pine shavings in a layer 3 to 4 inches deep. The pine oils in pine shavings have the advantage by reducing mold growth. Other options include rice hulls, ground corncobs, shredded newspaper or finely chopped straw (if it is changed often).

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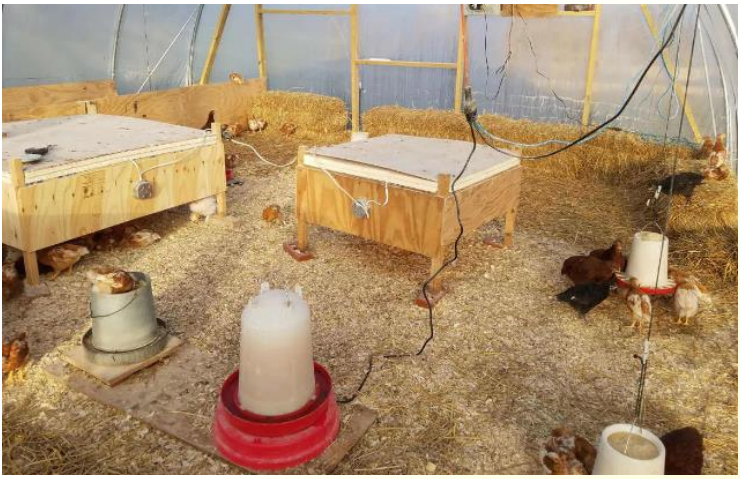
Hardwood shavings and peanut hulls should not be used because they can become moldy. Avoid sawdust because chicks may eat it and become impacted in their crop or gizzard. Large particle litter, like woodchips, is not useful for bedding because it is not as absorbent as smaller particle litter.



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Be attentive to the chicks when they are first introduced to the brooding enclosure. If a farmer sees his/her new chicks eating the bedding, he/she may choose to cover the bedding with newspaper or paper towels for the first couple of days, until they are eating their food well enough on their own. A poultry farmer should not use slick materials to cover the bedding as these may lead to leg injuries known as splay legs.

Brooding Equipment in Poultry

While brooding is an important management practice in poultry production, it is important to know the required brooding equipment. Remember, the purpose of brooding is to raise healthy chicks and provide the required heat (mimicking the mother hen) until they are able to adapt and regulate their body temperature to the ambient temperature.

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For brooding to be successful, there is some equipment that must be available in the brooder house/pen.

These are the equipment used for brooding:

- Shelter
- Bedding material
- Feeders
- Drinkers/waterers

- Heat source/Brooders
- Brooder guards
- Thermometers

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Shelter

It is important to provide a clean, dry area for the hatchlings that will protect them from predators, cold and rain, and hot sun. Almost any small building that meets the floorspace requirement for the size of the flock can be used. It is even possible to raise a small number of hatchlings in the corner of a garage.

Bedding Material

Provide bedding material, or litter, for hatchlings that will absorb moisture from the manure and keep the brooding area clean. A variety of materials can be used as bedding material, including wood shavings (most effective), ground corn cobs, peanut

and rice hulls, and hay or straw that has been chopped into smaller pieces. Note that unchopped hay or straw is ineffective as a bedding material. Never place hatchlings on a slick surface such as cardboard, plastic, or newspaper; smooth surfaces can lead to leg problems.

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Heat Source/Brooders

A farmer must provide his/her hatchlings with a heat source, typically a brooder or a heat lamp, because hatchlings are not able to regulate their own body temperature for the first few weeks of life. There are many different heat sources that can be adapted for use in small flocks.

Types of Heat Sources/Brooders

There are different types of brooders. They are:

- Electric brooders
- Infrared heat lamps
- Gas brooders
- Commercial brooders
- Portable brooders
- Stationary brooders

Electric Brooders

Typically hanging over the chicks' heads, the electric systems or lamps supply a heat source to keep the chicks warm. While white light is popular, it can disrupt the chicks' sleep patterns as the electric brooder emits light and heat - unlike an infrared alternative.

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Infrared Heat Lamps

For smaller flocks an infrared heat lamp is more practical. Suspend the lamp with a chain or wire (do not use the electrical cord) so that the lamp is at least 18 in. above the bedding material. In winter, it is important to make sure the space where hatchlings are kept is insulated so that heat lamps can keep the area sufficiently warm. A two lamp unit provides a backup in case one lamp burns out during cold weather. Before installing a heat lamp, make sure that porcelain sockets approved for

these lamps are available, and be sure that the lamp cannot fall to the ground, where it could become a fire hazard.

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Gas Brooders

Gas brooders, such as the Gasolec brooders, will convert natural gases or methane into a heat source for the chicks. As with electric lamps, gas brooders

often take the same form and hang above the chicks to keep them cozy. They are typically easy to use and can also have infrared features.

Commercial brooders

Commercial structures have the space for many chicks while still supplying heat. These vary in shape and size and will use different heating methods, such as gas, infrared, or a combination.

Portable brooders

Portable or mobile structures are significant on a small scale. For example, heating plates are excellent if a farmer does not have a significant structural brooder to move around. The portable option is perfect if a farmer is only rearing a handful of chicks. By making the brooder mobile, the chicks can also be moved seasonally.

Stationary brooders

Stationary brooders are typically easier to insulate as they remain fixed, making them great for monitoring. However, these systems can be more challenging when it comes to cleaning.

Farmers' Frequently Asked Questions Answered

How do I choose the suitable brooder for my poultry farm?

This depends on how many chicks you have or plan to have and what the conditions are like on your farm. However, while you can choose flexibly, it is been noted that infrared features are essential in keeping chicks happy and without disturbed sleep.

Brooder Guard

For the first seven to ten days after hatching, use a circular barrier called a brooder guard to confine hatchlings. The brooder guard should be about 15 to 16 inches high. Most brooder guards are made of cardboard. The brooder guard prevents the

hatchlings from wandering too far from the heat source and reduces drafts of cold air. The area surrounded by the brooder guard should be large enough for hatchlings to move toward or away from the heat source to find their temperature comfort zone. When the hatchlings are seven days old, the brooder guard can be removed.

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Thermometer

It is important to have a room thermometer inside the brooding pen or house. It is used for monitoring the ambient temperature inside the brooding house. With the help of the room thermometer, a farmer will know if the temperature within the brooding house is cold, moderate or high.

Feeding and Watering Equipment

Young poultry require feeding and watering equipment designed to accommodate their small

size. Hatchlings do not have an innate ability to recognize food. They will peck at small particles, nutritious or not. When hatchlings are raised with their mothers, their attention is directed towards nutritious items as they follow their mothers. Especially when raising hatchlings without their mothers, a poultry farmer must have feed readily available for young birds. For the first day or two after the hatchlings' arrival, put feed in a shallow pan or egg carton without a lid, which will make it easy for the hatchlings to find the food. As the hatchlings get older, provide bigger feeders.

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Feeders

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Feeders are necessary to provide chicks with food. The best feeders are those that minimize waste while providing enough feed for the chicks. There are many different types of feeders on the market, so it is important to select a feeder that is designed specifically for chicks. There are feed trays and flip-top feeders for this purpose.

Chick Waterers/Drinkers

Drinkers/waterers are necessary to provide chicks with water. Like feeders, there are many different types of drinkers on the market, so it is important to select a drinker that works for chicks and young birds. There are nipple drinkers and fountain drinkers for chicks.

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Brooding Environment

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The brooding environment consists of:

- Temperature
- Relative humidity
- Ventilation
- Lighting

Temperature

Theoretically, chick brooder temperature is measured with a thermometer placed 2 inches (5

cm) above the brooder floor (and at the outer edge of a hover), but there is no need for a thermometer. Just watch the chicks, and adjust the temperature according to their body language.

Chicks that are not warm enough due to insufficient heat or to draftiness crowd near the heat source, peep shrilly, and may have sticky bottoms or outright diarrhea. In an effort to get warm while they sleep, the chicks will pile up and smother each other. Piling is most likely to occur at night when the ambient temperature drops, so in cold weather check the chicks before going to bed, and if necessary, increase the heat overnight.

Chicks that are too warm move away from the heat, spend less time eating, and as a result grow more slowly. They pant and try to get away from the heat source by crowding to the brooder's outer edges, perhaps smothering one another. If the brooder is

hot enough to raise their body temperature above 117°F (47°C), chicks die.

Happy chicks that are warm and cozy wander freely throughout the brooding area, emit musical sounds of contentment, and sleep sprawled side by side to create the appearance of a plush down carpet. The sight can be dramatic to someone who has never seen chicks resting comfortably.

Relative Humidity

The ideal relative humidity to maintain during brooding is between 50-65 percent. High relative humidity may cause wet litter which results in high ammonia levels inside the brooding house, causing Coccidiosis. While low relative humidity may cause respiratory problems. The only way to solve or reduce air quality problems once they have occurred is to adjust the ventilation of the brooding pen very early in the morning.

Ventilation

Good environmental control during brooding in poultry farming requires properly executing the minimum ventilation basics. Never heat the house at the cost of ventilation. Use minimum ventilation during brooding. The ventilation of the brooder house is restricted to 1-2 weeks.

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Lighting

Light stimulation encourages feed and water consumption in chicks and thus helps them grow and perform better. Provide adequate lighting for the birds.

Brooding Management

Brooding Management in Poultry is done in the first 14 days period of the broiler poultry life – which is the most sensitive period because the bird is changing from an immature system to a mature system. For a better and profitable poultry

production we cannot ignore good brooding management practice.

Brooding Area and Litter Management

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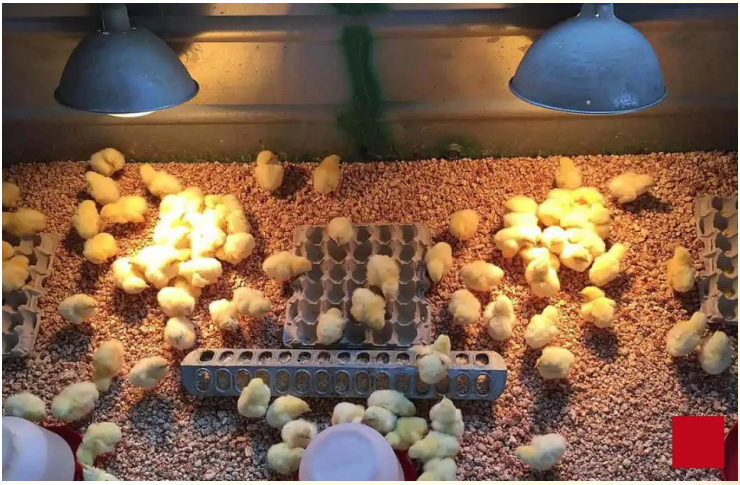

Clean and disinfect brooding area for 1 or 2 weeks before the arrival of flocks. Provide fresh, dry, and comfortable bedding conditions for the chicks. Check the fittings, temperature control, feed, and water trough arrangement before bringing in the chicks into the brooding area. Avoid a damp brooding area. Use a deep litter system. Discourage

litter eating by the chicks and remove caked litter as soon as after the birds leave.

Feeding and Watering Chicks

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Young chickens should be fed from three to five times daily, depending on one's experience in feeding. Undoubtedly, chickens can be grown faster by feeding five times daily than by feeding three times daily, but it should be borne in mind that more harm can be done to the young chickens by overfeeding than by underfeeding, and at no

time should they be fed more than barely enough satisfy their appetites and to keep them exercising, except at the evening or last meal, when they should be given all they will eat. Greater care must be taken not to overfeed young chicks that are confined than those that have free range, as leg weakness is likely to result in those confined.

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Also, the chicks must be provided with fresh, clean, and cool water of optimum quality with temperature similar to room temperature. Pay close attention to initial drinker height, and make adjustments that reflect bird growth on a routine basis. Make sure every chick gets to feed and water quickly and easily.

From the first day of brooding, ensure chicks are feeding well to maintain uniformity to achieve maximum output.

Early Chick Mortality

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Chicks are very frail, especially during the first few weeks of their life. Hence, it is imperative to have sound management to keep your flock healthy. Moreover, irrespective of the quality of the chicks

supplied/procured and the robustness of management, early chick mortality cannot be avoided entirely. 1-5% of mortality is normal in a poultry farm; however, anything higher than this should be taken seriously.

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A high mortality rate is indicative that something is wrong with the flock, and it demands the poultry owner's immediate intervention and appropriate action to stop further losses as failure to do so may lead to huge losses. Many factors cause early chick mortality, such as genetic, management, disease,

and nutritional causes. Here in this section, we are sharing about the cause of early chick mortality and ways to reduce the chick mortality.

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What causes early chick mortality?

There are myriads of causes of early chick mortality. However, the most common factors are:

- Genetic causes.
- Management causes.
- Nutritional causes.
- Disease causes.

Genetic Causes

There are around 21 lethal gene mutations in birds. Most of these lethal genes lead to chicks' death during the incubation period. However, congenital tremors and congenital loco cause the death of chicks within a week of hatching.

Management Causes

Another most important cause of early chick mortality is – Poor management. Sound management is indispensable for keeping flocks healthy and alive. Chicks reared in poorly managed poultry will not be able to manifest their full genetic potentials. Some of the management blunders include.

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High Brooding Temperature: High brooding temperature is dangerous for your flock. Too much heat makes chicks dehydrated due to which they consume more water rather than feed. Due to their reduced feed intake, their growth is drastically affected, leading to their death. Besides, it also causes pasted vent (i.e., feces stalked around the vent area block the vent, ultimately resulting in chicks' deaths because of their inability to pass out waste from the body).

Low Brooding Temperature: Low brooding temperature causes chilling, and prolonged exposure to cold can directly impact the immune system of the flock, thereby making birds vulnerable to diseases. Besides, flock tends to huddle together when exposed to too much cold to keep themselves warm. Huddling causes suffocation in the flock, thereby resulting in chick mortality.

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Poisoning: The mortality rate due to poisoning is also high in early chicks. It, however, depends on the type, dose, and duration of exposure. Poisoning mortality could be sudden and dreadful. The reason for poisoning could be any from feed to excessive salt intake, herbicides to insecticides, and disinfectants, etc.

Litter Contamination: Another most crucial cause of chick mortality is -contaminated bedding

materials. Some farmers use sawdust for brooding, which could be really harmful to chicks. Chicks can mistake sawdust for feed, and in the process, they consume it in good quantity, which leads to gastrointestinal impaction and ultimately resulting in death.

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Starvation: Starvation is another cause of chick mortality because young chicks do not have fat storage to fulfill body needs during starvation, resulting in death.

Injuries: It is important to handle chicks carefully during vaccination, sexing, dubbing, de-beaking, transportation from brooding farm to rearing farm, etc.; otherwise, it can cause injuries and ultimately result in death.

Inadequate Feeders and Drinkers: Using wrong feeding and drinking equipment can also cause

chick mortality. Inadequate feeders and drinkers affect flocks' performance. It also leads to feed wastage and water spillage that results in the wet litter, which is a suitable condition for disease outbreak. Less feeder and drinker, on the other hand, cause starvation, ultimately leading to death.

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High Relative Humidity: High relative humidity causes the dampness of litter material in the brooding house, facilitating the growth of microorganisms, a suitable condition for disease outbreak.

Predators: Poorly constructed brooding houses are again a cause of chick mortality. Predators, such as hawk, rat, dog, cat, snakes etc., can easily make their ways in the brooding place and attack chicks.

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Nutritional Causes

Water: Water is one of the essential elements for maintaining the health and performance of the birds. It not only acts as a transport medium for

nutrients and metabolic end products but also it helps in maintaining body temperature during hot weather. Besides, water balances the minor deficiency of minerals like Na, Cal, K, etc. Unhygienic water causes high mortality.

Fat Soluble Vitamin Deficiency: Vitamins A, D, E, and K are fat-soluble vitamins. These Vitamins are required for normal growth, development, and reproduction of chicks. A high deficiency of fat-soluble vitamins can cause death. In comparison, minor deficiency of these vitamins results in cessation of growth, lacrimation, rickets, ruffled feather, exudative diathesis, anemia, etc.

Water-Soluble Vitamin Deficiency: Vitamin C and B-Complex are water-soluble vitamins. Water-soluble vitamins are an essential part of poultry diets. They are required for the metabolism, reproduction, growth, and development of chicks.

Severe deficiency of these vitamins can cause death; however, minor deficiency leads to poor feathering, low growth, weight loss, dermatitis, nervous signs, and anemia, etc. in chicks.

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Diseases

Young chicks are susceptible to infections and diseases due to a lack of immunity during the first six weeks. It is crucial to maintain biosecurity measures; failure to do so increases the chances of a disease outbreak. Pullorum is again a bacterial infection characterized by ruffled feathers, labour breathing, white diarrhoea, chirping, and death.

Chicken Anaemia Virus Infection: Chicken anaemia virus infection or CAV is an acute viral infection found worldwide. It can infect chickens of all ages; however, it is mostly detected in young chickens. CAV affects the immune system of the chicken, thereby leaving it more susceptible to

other infections. However, mortality is often a result of secondary infection.

Salmonellosis: Salmonellosis is a group of acute rapidly spreading diseases characterized by a rise in body temperature, omphalitis, hepatitis, and septicaemia, enlargement of the spleen, arthritis, and death. It affects all ages.

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Ways to Reduce Early Chick Mortality

If a high mortality rate is being recorded in a farmer's poultry farm, it is alarming, and he/she needs to take appropriate actions. Failure to do so can cost a farmer all his/her investments. Here are the steps that can be taken by a poultry farmer to reduce chick mortality in his/her poultry farm.

Buy chicks only from trusted suppliers

First things first, buy quality chicks from trusted suppliers. More often than not, the problem begins

when you buy poor quality and unhealthy chicks. Most of the health problems affecting birds are due to low genetic background. Hence, it is vital to buy chicks from a reputable and trusted supplier who raises healthy parent stocks. It is also important to know the source of eggs of the hatchery that supplies chicks to you along with the history of the birds that lay those eggs.

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Inspect the health status

No matter how reliable the supplier is, it is always advised to inspect each bird's health status before transporting them to the farm.

Provide the flock with adequate brooding temperature

High and low brooding temperatures lead to high chick mortality. Hence, it is essential to provide your flock with a proper brooding temperature.

Failure to do so can wreak havoc on your poultry farm.

Protect your flock from cold weather

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Of course, even in a farmer's wildest dream, he/she would not want to see his/her chicks dying because of cold weather. So, it is important to supply them with heat during very cold weather. A farmer should consider designing the pens in such a way that his/her birds are not exposed to extremely cold conditions.

Keep drinkers and feeders clean

Being a poultry owner is not an easy task. You need to take care of the flock and their needs to keep them healthy. Keeping the birds' feeders and drinkers or drinking trough clean is very important. So, make sure the drinkers and feeders are cleaned every morning and discard any leftover water and

feed. Also, do not fill drinkers with chlorinated water.

While discarding leftover water and feed, make sure it is done very far away from the pen. It will help in preventing soldier ants from invading the farm and killing the chickens.

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Minimize the risk of suffocating the chicks to death.

Birds can quickly suffocate and die when forced to move in the tight corner or inadequate temperature. In a very cold atmosphere, they huddle to keep themselves warm, due to which the birds can suffocate or suffer a fatal injury. To avoid this, make sure that the brooding house's temperature and humidity are at the right levels and uniform throughout the pen.

The best way to protect birds from suffocating to death is to centralize the pen's heat source. With the

heat source in the middle, the birds can be protected from huddling.

Avoid entirely sudden loud noises around the birds. Birds get panic with a sudden loud noise due to which they pack together and suffocate.

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Try in as much as possible to keep predators away from the farm. Birds get scared when they see predators, which leads to a panic-induced gathering that results in suffocation.

Prevent the farm from infections and diseases

Some diseases can be gruesome; they can wipe out your entire flock in a go. While some may not be so fatal but may affect the feed conversion ratio of the birds. So, it is crucial to keep checking your flock regularly. In case you detect symptoms for any disease in a bird, immediately separate it from the flock and contact the vet to avoid further damage to your poultry.

Do not feed birds with moldy feeds

Moldy feeds can be dangerous and poisonous to your flock. Feeding your birds with moldy feed can lead to severe problems, such as poultry disease. The best way to avoid moldy feeds on your farm is to keep the feeds away from water. Also, do not store the feed in storage rooms with very high humidity.

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Besides, do not buy in bulk. Buy only that much that the birds will finish before the end of its shelf life. And check the expiry dates on the feed before making the purchase.

Serve birds water before feeds

Serve the birds' water before feeds; it will prevent the flock from stampeding while struggling for food. Birds tend to drink water slower than they peck on their feed. Serving water first will divert

some of the birds' attention to water, which will reduce the intensity of the struggle for feed.

Keep the farm protected from predators

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It is imperative to keep predators away from the farm. However, complete protection cannot be ensured as some of the predators sneak in from the underneath or the roof. The best way to keep more giant predators like dogs and cats from the range area is by using an electric fence. For flying predators like hawks, crisscross a thin cord over the area to prevent them from flying in and out.

Besides, close all the holes around the farm and keep monitoring the farm for predators' signs. A farmer can even install strong iron mesh nets around the pens and apply predator repellents regularly.

Regularly clean dirty poultry pens

It is essential to clean filthy poultry pens regularly. Ammonia starts to build up in the pen when the litter is wet or when it is left unattended for a long time. This ammonia gas can be hazardous to the birds. When it exceeds 25 ppm, it leads to severe problems, like stress, inadequate feed intake, irritation of the eyes and nasal membrane, slow growth rate, and respiratory diseases like coryza, bronchitis, etc.

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Thus, it is essential to remove wet or caked litter from pens to prevent your birds from mortality due to choking or other respiratory problems.

Supply sufficient feed to your birds

The improper or insufficient feed can lead to poor growth and development of birds. When underfed, birds have low body weights and poor immune responses, due to which they fall sick easily.

Likewise, overfeeding can also lead to more significant problems. That is why it is vital to give them enough feed.

Strictly follow medication and vaccination schedules

Following medication and vaccination is a good farm practice that can help each poultry farm owner greatly. By following medication and vaccination, you can keep endemic disease outbreaks at bay. Make sure you get your birds are vaccinated against contagious diseases like Colibacillosis, Newcastle Diseases (ND), Fowl Typhoid, Chicken Anaemia Virus Infection, Gumboro Disease, Fowl Pox, etc.

Talk to the vet and get the right vaccination and medication schedule for the poultry species you're raising. You can also keep a stock of the medicines at the farm to reduce chick mortality.

Have a vet regularly check the flock

Have a vet regularly checking your flock of chicken to ensure there are no symptoms of contagious diseases. Remove recovered from the flock as recovered birds are a reservoir of infection. This way, you can keep your other birds safe and healthy.

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Managing Health and Disease Prevention

Although young birds are fragile and can get sick very easily, many diseases can be prevented by keeping the poultry house very clean.

Diseases such as E.coli Infection, Newcastle Disease, Aspergillosis, Coccidiosis, among others, affect birds at an early age and are caused by nutrient deficiency or by bacteria and viruses. Even overcrowding can also cause diseases in birds.

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To prevent diseases and maintain the health of the flock, it is necessary to vaccinate chick against various diseases. Also, ensure adherence to critical biosecurity measures during and after the brooding period.

Examine chicks one after the other for signs of defects before placing them under the brooder. Remove all dead chicks from the flock to prevent cannibalism and possible infection by pathogenic organisms. Also, the drinker should be taken out and washed thoroughly before being filled with clean cool water. Avoid overcrowding and daily

inspect the condition of birds and their faces for any sort of abnormality. Follow a regular vaccination schedule.

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Standard Chicken Vaccination Schedule

Vaccination regime recommended for commercial layer and broiler chicks, but the bold printed ones are also applicable to improved management of indigenous chicken.

Age	Vaccination Against	Application
Day 1	**Marek**	Sub cut (neck)
Day 1	**Newcastle disease**	Eye or nasal drop
Day 7-9	**Gumboro**	In drinking water
Day 10-14	Newcastle (Lasota) + IB (infectious Bronchitis	In drinking water or eye/nostril drop
Day 16-18	**Gumboro**	In drinking water
6th week	Newcastle (Lasota) + IB	In drinking water
6 - 8th week	**Fowl Typhoid**	Injection
8-9th week	Deworming (every 8 weeks)	In drinking water
8 - 10th week	**Fowl pox**	Wing stab
12 - 14th week	**Fowl Typhoid**	Injection
16 - 18th week	Renewed Newcastle (then repeat every 3 months)	Optional

The bold ones are also needed for small holder chicken flocks (including indigenous chicken).

Gradual Transition to the Outdoors

Successfully transitioning young poultry from their brooder to permanent outdoor facilities requires following a few common-sense guidelines. First determine that the birds are ready to move from their brooder, taking into consideration such factors as how well feathered the birds are, and outdoor temperatures during both daytime and nighttime.

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Degree of Feathering

Fully-feathered poultry are generally ready for a permanent move to outdoor housing. How fast poultry feather out depends on the species, breed and brooding temperature. As a general rule, a farmer can expect:

- chickens to fully feather at approximately 5 to 6 weeks

- ducks to fully feather at approximately 7 to 9 weeks
- turkeys to fully feather at approximately 8 to 10 weeks.

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Within each species, different breeds feather at different rates. Speed of feathering also depends on brooding temperature. Within the birds' comfort zone, a temperature slightly on the warm side will result in slow feathering, while a temperature slightly on the cool side will increase the rate of feathering.

Ambient Temperature

An often-stated rule of thumb is that the brooding temperature should start at 95°F and be reduced 5°F per week for the first six weeks, or until the brooder temperature is the same as the daytime temperature outdoors. At that point, young poultry

should no longer require auxiliary heat and can safely be moved outdoors.

Of course, that is assuming the ambient temperature is 65°F to 70°F. A lower ambient temperature can require a longer brooding period. On the other hand, if the outdoor temperature is higher than brooding temperature and conditions are dry, young poultry may be moved out of the brooder sooner.

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Weather conditions are a big factor in determining the best timing. Where turkeys are involved, many growers keep their birds off the ground until they are at least 12 weeks old, to avoid damp or chilling weather conditions that can kill young turkeys.

Ducks love wet conditions, but they too will suffer if they get chilled. Because ducks make such a mess in the brooder, they might be moved to a protected

outdoor facility at an early age. Alternatively, a farmer could put them outdoors on warm days and bring them back in at night.

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Gradual Transition

A big factor in successfully moving young poultry from the brooder is to make a gradual adjustment to let the birds get acclimated to outdoor conditions. Birds that no longer require brooder heat will acclimate rather quickly. Never abruptly move poultry from a heated brooder to permanent outdoor facilities. Where nights are chilly, the birds might be brought back indoors overnight. Or, heat might continue to be provided in the outdoor coop, at least during the night.

Acclimation to lights-out at night is another important transitional measure. Before chicks are moved to an outside coop, they should get used to having the brooder lights dimmed or turned off at

night. Lights that go off suddenly at night can scare the birds and result in a pileup - birds piling on top of one another, smothering those unfortunate enough to find themselves at the bottom. Because pileups occur most often after dark, birds that learn to bed down naturally as dusk falls generally will not pile.

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Another acclimation option is to furnish brooded birds with a sunporch fully enclosed with hardware cloth, where they can choose to spend time outdoors during the daytime. A sunporch, made available when chicks are 3 to 4 weeks old, allows the birds to acclimate at their own pace. Every evening for the first week after opening access to the sunporch, make sure the birds have gone back inside for the night.

After the birds are moved to the outdoor coop, keep them confined inside for the first few days

before opening the door to the outside run. Once they are given access to a run, check every evening for the first week or so, to see that they go back inside. Birds that remain in a cold, damp, drafty run overnight may pile or chill.

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Number of Birds

Additional transitional measures relate to the number of young birds in relation to the size of the outdoor housing. A sizable number of birds may generate enough heat to keep themselves warm overnight, assuming their housing is not damp or drafty. Just a few birds in a big coop, however, might need a little help, such as confining them to a smaller portion of the coop, or providing them with auxiliary heat until nighttime temperatures improve.

The natural instinct of chilled poultry is to huddle together to stay warm. Huddling can result in

pileups. Temporarily rounding the coop's corners helps prevent young birds from getting trapped in a pileup. Corners may be rounded with boards or stiff cardboard, or each afternoon bedding may be pushed into an incline at all corners.

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Piling may also occur when chicks are moved from a brooder with a low overhead to a coop with a high ceiling, where they feel less safe. An easy fix is to prop a small sheet of plywood on blocks at the four corners, giving the chicks a place to safely "hide" underneath.

By gradually transitioning birds and taking into consideration outdoor temperatures, the number of birds and their degree of feathering, a farmer can successfully move young poultry from their brooder to permanent outdoor facilities.

Troubleshooting Common Brooding Issues

Young chicks grow fast; one day they are tiny balls of yellow fluff and the next they are gangly, awkward-looking creatures midway between chickdom and adulthood. For poultry, the brooding period runs from day-old up to eight weeks of age, and is a critical time in a bird's development, one that can have a significant impact on a farmer's bottom line.

At first glance, brooding chicks does not seem like rocket science; they need to be kept warm, dry and provided with ample food and water. Unfortunately, what sounds like an easy task can become a balancing act involving constant monitoring, adjustments and know-how. For those farmers who put that extra time and effort into the brooding period they will be rewarded with happy, healthy and profitable birds.

Maximize the flock's potential by recognizing and addressing brooding issues before they become brooding nightmares. Remember that mistakes made in brooding management often cannot be made up for later in development, and even a few hours of poor conditions can have a negative impact down the line.

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Here is a rundown of where brooding management can go wrong, and how to stay on track:

Chilled or overheated chicks:

This cannot be stressed enough: proper temperature control is the single most important thing a farmer can do to ensure his/her chicks are healthy. A chick who is cold will not eat or drink properly, and will be susceptible to illness and disease. If the chicks are panting and standing with their wings spread a farmer should know his/her

brooder is too warm; if the chicks are huddled in a corner then the farmer ought to know that his/her brooder is too cold.

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Using either a heat lamp or chick heater, a brooder should be kept at 95 degrees Fahrenheit (35 Celsius) for the first week, following which the temperature is reduced by five degrees Fahrenheit every week. Make sure the temperature is in the correct range throughout the brooder by buying a couple of thermometers and placing them in different areas.

Temperature control begins as early as when the birds are picked up from the supplier. Do not just throw the chicks into a box in the back of a truck and drive away; transporting can be a major source of stress - remember, these chicks just hatched literally the day before, and may already have been

in transit for hours before reaching a farmer's premises.

Underfed or dehydrated chicks

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If chicks are not growing properly, and appear malnourished or dehydrated, there are a couple of potential culprits. To begin with, make sure the chicks are being fed a commercial chick starter, mixed exclusively with the nutritional needs of chicks in mind. Make sure the feeder is low enough for the chicks to find easily and there is sufficient room around it for everyone to get their fair share. The drinker/waterer should be similarly accessible and should contain clean water, checked regularly.

An often-overlooked cause for underfed or dehydrated chicks is the lighting program. If chicks cannot see their food or water, they cannot eat, and if they cannot eat, they cannot grow. Maintaining adequate lighting is a balancing act; ideally a farmer

may want his/her chicks to have several hours of darkness each day, but with enough daylight hours to encourage eating and drinking.

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A common assumption is that 24 hours of light each day will be to the benefit of the chicks, but periods of darkness can not only give chicks an opportunity to rest, darkness can also help simulate a natural circadian rhythm that will regulate hormone levels and improve a chick's immune system. For broilers in particular, periods of darkness can be a way of regulating rapid growth by restricting feeding hours. For broiler chicks, a good lighting program is 14 hours of darkness per day from days 7 to 21.

Sick chicks

Chicks who are sick will act and look sick. If the chicks appeared healthy when they were being picked up and became sick after the first day, it is a

good bet the farmer's brooding management is the culprit.

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Proper brooding management - adequate ventilation, ample food, clean water and a warm environment - is a farmer's best defence to illness; anything less can cause a weakened immune system and susceptibility to disease. If other birds are being kept on the farm, failing to follow proper biosecurity protocols can also introduce illness into a young flock of birds.

Another consideration is bedding - one of the biggest breeding grounds for disease can lie directly beneath the chick's feet. Bedding that does not absorb moisture can become a place for disease or mould to flourish. The preferred bedding for chicks is shavings, which absorb moisture well, but will not mat and stick to a chick's feet like straw.

Moving them out

It is time to move chicks out of the brooder into a bigger coop when they are well-feathered, typically at five- to-six weeks of age and when the temperature is in the 65 degrees Fahrenheit (18 degrees Celsius) range. If the chicks are being incorporated into a larger flock of birds, the farmer should make sure there is sufficient room to prevent chicks from being bullied.

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When moving chicks to the big house, try inverting a cardboard box in the coop, with an opening big enough for chicks to enter but not big enough for a full-grown bird. This gives the chicks somewhere to hide from the rest of the flock if they are feeling threatened, but allows them the freedom to get used to the flock dynamics on their own schedule.

The keyword is: stress-free

Ideally, chicks should be living the high life in the brooder - relaxed, comfortable and warm, enjoying their chick lives. With chicks, less stress means healthier birds, and healthy birds means happy farmers.

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Brooding Issues Specific to Waterfowl

Waterfowl can be brooded much like chickens, with a few special precautions:

- Although no hatchlings should be placed on slippery bedding material, having appropriate bedding material is particularly important for waterfowl. Slippery surfaces can result in **spraddled legs**. Paper towels, cloth, or burlap provides the best traction.
- Do not raise waterfowl on mesh wire. Small waterfowl can get their hocks stuck in the mesh wire when they sit down to rest.

- Do not let young waterfowl swim or become excessively wet for the first four weeks of life. Young birds that become wet chill easily, and when chilled, they tend to crowd together and flip onto their backs, resulting in death.
- Do not feed medicated chicken feed or feeds for other poultry to young waterfowl. Waterfowl can have adverse reactions to some poultry medications. If possible, use a starter feed that has been formulated for waterfowl. Pelleted feeds are usually best as waterfowl tend to waste feed, especially when it is finely ground into mash.
- Ducklings do not require as high a brooding temperature as chicks. At hatch ducklings require a temperature of about 86°F. The temperature can be reduced by 5°F each week until it reaches 55°F. High temperatures may result in slow feathering and reduced growth. By

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four weeks of age, ducklings should be fully feathered.

Farmers' Frequently Asked Questions Answered

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What is efficient brooding?

Providing at reasonable costs a suitable and comfortable environment for the development of chicks from hatching time until they can do without heat.

What are the essentials of a good brooder house?

(1) Weather proof-keep out the rain, wind and cold. (2) Retain the heat or prevent heat leaking out too rapdly. (3) Be well and evenly lighted with windows arranged so that direct sunshine may enter. (4) Built, arranged, and equipped to save labor and maintain sanitation.

What size and type of brooder house is best suited for the average farm?

The 10' x 12' colony brooder house with sun parlor has proven highly satisfactory. 'It will accommodate 300 chicks, the num-ber necessary for adding 100 pullets each year to the average farm flock of 150 hens.

Why are mo·vable brooder houses recommended?

Movable houses permit the use of clean, fresh ground that is free of disease contamination. Worm infestation, low vitality, and much of the death loss is due to the use of ground chickens have run over year after year.

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Is it advisable to build a double floor in brooder houses?

Double floors are recommended for early broods or when early broilers are produced. A more unifrom temperature can be maintained in cold weather at a lower fuel cost.

What is the value of insulation in a brooder house?

Insulation may be compared to the double floor. It prevents heat leaking out of the house, thus it saves fuel and insures more uniform temperature.

Why are sun parlors so highly praised and widely used?

Points in favor of the sun parlor are: (1) It economically enlarges the brooder house. (2) Chicks are permitted to get away from the heat and exercise in cool air. (3) Direct sun- shine is· made accessible. (4) Chicks are kept off the ground and the danger of coccidiosis or othe1' diseases lessened. (5) Sun parlors make brooding more successful.

To what extent may hardware cloth be used in brooder houses?

As feed and water platforms only.

Why not use hardware cloth for the whole floor area?

(1) Hardware cloth floors make drafts more difficult to con- trol. (2) They encourage cannibalism. (3) Cleaning is equally, if not, more difficult. (4) Floors of hardware cloth cannot be walked upon by caretaker.

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In addition to the ·house what is required in the way of brooding equipment?

Efficient, labor saving sanitary feeders and waterers, and the brooder stove.

How much feeding space should be provided?

Half to two-thirds of the chicks should be able to eat at once. This would require about 12 feet of feeder space per 100 chicks. One-third of the· chicks should be able to drink at once.

What type of brooder is best adapted to colony house use-Electric, kerosene, or hard coal?

Electricity is probably more nearly fool-proof and uniform but it is also more expensive and requires a well

insulated house. Not recommended for movable houses or early brooding without auxiliary heat.

Kerosene burning brooders of the drum type equipped with a chimney for removing the poisonous fumes and an overflow pipe to lessen the fire hazard are proving quite satisfactory. These are less expensive than electric brooders but more ex- pensive than hard coal burning brooders.

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Hard coal brooders are less expensive to operate but probably more difficult to regulate and maintain uniform temperature, particularly in windy weather.

How much space do chicks require in a brooder house?

Two chicks per square foot of floor space has proven most satisfactory.

How many chicks should be brooded in a unit?

Over 300 chicks in a brood generally require an experienced poultryman. Many farm poultry raisers who try brooding large broods have heavy losses.

What kind of litter is best in the brooder house, straw, chopped alfalfa, sand, peat moss, 'or shavings?

Profitable brooding is a matter of lowering the costs. For this reason, farm flock owners are encouraged to use material available on the farm such as fine, clean straw or chopped hay. Peat moss is good but the price makes its use expensive. Clean sand, if available, is good provided the chicks are fed· as soon as they are put into the brooder house.

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What is the proper temperature for brooding chicks?

A temperature of 95° F. at the outer edge of the hover and about two inches above the floor is recommended at first. This may be reduced at the rate of five degrees per week.

How long should chicks stay in a brooder?

Chicks should stay for between three (3) to four (4) weeks in a brooder when they have fully developed feathers and no longer need artificial heat.

At what age are chicks taught to roost?

Successful poultry raisers advise putting in roosts at the end of the first week.

What kind of roosts are used and how are they installed?

Slanting roosts supported with diagonally cut boards over which half inch mesh netting is first tacked. The roosts may be of any light strips· spaced about four inches apart.

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At what age are chicks given their first feed?

At about 36 hours of age or just as soon as they are put into the brooder.

What are they fed?

Dry mash containing the essential ingredients for health and rapid growth.

What are these ingredients?

Home grown feeds supplemented with protein concentrates. (Ground corn and oats, wheat, bran and shorts and alfalfa meal mixed with a small amount of dried milk and meat and bone meal.)

Does time of the year affect brooding? That is, winter or summer, irrespective of following and applying all best practises in brooding?

The time of the year can affect brooding, regardless of following and adhering to all best practices. In winter, brooding can be challenging due to the cold temperatures,

shorter days, and lower light intensity. These factors can disrupt the normal brooding environment for chicks and affect the success rate.

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In winter, the colder temperatures can make it difficult to maintain a suitable brooder environment. Chicks require a constant temperature of around 95 degrees Fahrenheit for proper growth and development. The colder temperatures in winter can make it challenging to maintain this temperature, which may result in slower growth rates and increased susceptibility to illness.

Shorter days in winter can also cause problems for brooding. Chicks depend on light to regulate their internal clocks, and the lack of sunlight in winter can cause them to become confused and disoriented. This can lead to problems such as poor appetite, decreased activity, and increased susceptibility to disease.

Lastly, the lower light intensity during winter can affect brooding. Chicks require sufficient light to grow and develop properly. The shorter daylight hours in winter can lead to a lack of adequate light exposure, which can

affect feather development, muscle growth, and overall growth.

It is important to note that while winter can pose challenges for brooding, following and adhering to best practices can still help improve the chances of success. Providing a warm, draft-free environment, ensuring proper ventilation, providing adequate food and water, and monitoring chick health and behaviour are all crucial

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Record-Keeping and Evaluation

Even if maintaining a small flock, record keeping helps keep track of a poultry project's expenses. It can aid in monitoring the progress of the flock. Records are important to the financial health of a business or operation.

Efficient and profitable poultry operations are not guaranteed by good record keeping, but success is unlikely without them. Records are essential tools for management to maintain a successful

flock. Record keeping involves keeping, filing, maintaining, and categorizing inventory, financial and production information for the flock. This can be accomplished by hand recording or by using computer software.

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Record keeping is important. Records tell an owner or manager where the business/operation has been and the direction in which it is going. Records show the strength and weaknesses of the poultry operation. They provide useful insight to financial stability for a farmer's flock. If there are any shortcomings, records will show where adjustments can be made. Along with showing where adjustments can be made and being a good reference tool, there are several other purposes of record keeping.

For the good managements of poultry keeping, farmers are advised to update all records books

accordingly. In case of a busy poultry farmer who hardly finds time to record or go through the books, he/she must employ someone to do this task for him/her because it helps the farmer keep the track of everything that is going on among the birds and the farm at large.

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One of the first steps in being a successful farm manager is keeping well-maintained, accurate records and establishing a sound record-keeping system. Keeping accurate records has its benefits, like helping farmers plan and complete realistic forecasting for the next year.

The Importance Of Keeping Poultry Records

If anyone is thinking of starting a poultry flock, he/she will also want to know the importance of keeping poultry records to help him/her plan his/her operations. A poultry farmer will want to know how much feed is he/her birds are getting, how often they are eating, and if they are gaining weight.

Poultry farms are a great way to make money on a small scale. But it takes a lot of hard work and dedication to keep things running smoothly. There are a lot of different aspects to managing a farm, and a farmer needs to be on top of them all if he/she wants to be successful. The first thing a farmer needs to do is to keep good poultry records. Record keeping is the foundation of any good poultry operation. It is the job of a poultry farm owner to manage his/her flock to ensure its health and safety.

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The importance of keeping poultry records cannot be over-emphasized. By keeping a record of feed, water, medicine, and other items used on the poultry farm, a farmer can keep track of what happens to his/her chickens and how well they are doing. In addition, a good record-keeping system

helps a farmer to manage his/her flock and improves his/her overall management skills.

What Is Record Keeping?

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Record keeping is taking notes about what happens on a farm. This includes recording information, such as feed, water, medicine, and other items used on a farm. It also includes documenting any problems or events that happen on the farm. A practicing farmer can use many types of records. For example, he/she can write notes in a notebook, use an electronic spreadsheet, or even use a computer program to keep track of the records.If the farmer has never kept records before, he/she may wonder what type of records he/she should keep.

The best way to figure out what records should be kept is to think about what the farmer wants to know. For example, if a farmer wants to know what

happened to his/her chickens when they were sick, he/she will need to keep a record of their health. In addition, a farmer can use this information to help plan for future needs.

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The first step in keeping records is deciding what information needs to be collected. A poultry farmer may want to keep track of:

- His/her flock's general health and performance
- What diseases and parasites are affecting the birds
- How much food and water does each bird gets
- The medications being given to the birds
- The time each bird spends outside
- The date of birth and death of each bird
- The date each bird was put into the flock

The goal of a good record keeper is to collect enough information to make informed decisions about the flock's health and well-being. This makes

it easier to identify problems early on, giving the farmer a better chance of treating illnesses and avoiding losses because of sickness and death.

Sustainable Practices in Poultry Incubation and Brooding

Brooder House Schedule Up to of 4 Weeks of age

- Ready the brooder to receive chicks
- Follow vaccination calendar (Newcastle, Chronic Respiratory Disease, Gumboro)
- Check weight of day old chick
- Keep the healthy chicks in the brooder.
- At first supply glucose water to the chicks
- After 2 hours, supply feed particles on paper or flat plates for first 2 days
- When the chicks have learned to drink, place drinkers to avoid wet litter.

- Clean, wash, and refill the drinkers every day with fresh, clean water.
- When all chicks have learned eating, feed may be provided in shallow feeding trough
- Keep antibiotics away by maintaining bio-security at early age.
- Start temperature with 95^0 to 90.5^oF. The brooder temperature should be reduced by 36^0 F at the end of every week till room temperature or 69.8^0F is reached.
- Check temperature every 2 or 3 hours interval.
- Check quality of litter
- Check feed register to confirm that the required amount of feed up to marketing or laying age is available.
- Light should be used at day and night for attraction of the chicks to eat and drink.

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- Brooder guard may be moved few centimeters apart every day so that growing birds may get more space.
- Keep brooder house well ventilated. Strong ammonia odor in brooder house is indicative of poor ventilation.
- Check live weight at every week
- Remove the dead chicks as soon as they appear.
- Keep necessary performance records.

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In summary, providing chicks with comfort and warmth is an important aspect of poultry production. Brooding in poultry farming should be done with the right equipment and following important management practices. Also, always keep in touch with a qualified veterinarian for help at the time of need.

HOM MADE POULTRY BROODERS

Home Made Chick Brooders

When baby chicks are brought home, they need a warm safe place to live. Here are some easy homemade brooders a farmer can make in a pinch.

Cardboard Box

A large cardboard box is probably the quickest and easiest way to get a brooder set up. As the chicks grow, move them into bigger and bigger boxes, or even try taping two boxes together to give them more room.

Since the boxes will likely be fairly tall, you do not necessarily have to cover the top as long as you do not have kids or pets who might get curious about the little chicks.

Cardboard is pretty flammable, and will get wet, so it is not a top choice for a homemade chick brooder.

Metal wash tub

A metal wash tub will double as a brooder in a pinch. It will not hold too many for long, but while they're small, I like using a wash tub because it is easy to carry outside to clean or to move the chicks to a different area of the house.

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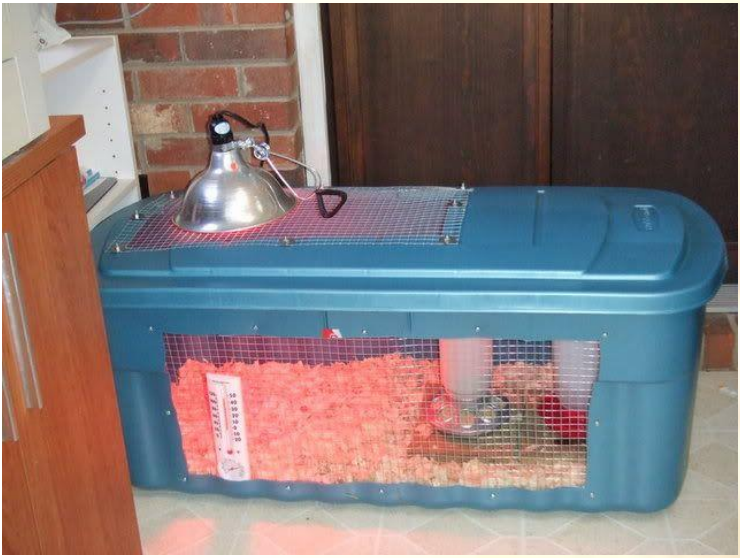
It will not catch on fire like a cardboard box might, and it can handle water spills.

Cutting a piece of screen or welded wire fencing to fit over the top is added insurance a farmer will not have any escapees.

Plastic Storage Tote

A large plastic tote makes a great brooder and offers a little more room than a wash tub. It is more impervious to spills and moisture than a cardboard box and a window can easily be cut in the lid to provide air and also keep the chicks from hopping out.



Dog Crate/Rabbit or Bird Cage

Any small animal cage will work wonderfully as a chick brooder, but a farmer will want to use some

cardboard (or plastic) along the bottom few inches at least to be sure his/her chicks do not squeeze through the openings and also to keep drafts out.

If there is a dog crate not being used or an old bird or bunny cage, then a farmer has got a perfect chick brooder.

GLOSSARY

Air cell refers to the pocket of air inside the egg at the large end. The air cell gets larger as incubation progresses.

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Albumen is the egg white.

Bedding is material scattered on the floor of a poultry house to absorb moisture and manure (also called litter).

Blastoderm is the nucleus of the egg when it is fertilized. Seen on the yolk.

Blastodisc is the nucleus of the egg when it is unfertilized. Seen on the yolk.

Blood Ring refers to a line or ring of blood inside an egg that has started to develop into a chick but quit at an early stage.

Bloom is the protective coating on freshly laid eggs that helps seal the pores of the egg shell. This prevents bacteria from entering the egg. Also called the cuticle.

Breed refers to a group of chickens having a distinctive body shape and the same general features; aslo a term used when group male and female birds for mating.

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Brood is to care for a batch of chicks.

Brooder is a devise used to provide warmth to young chicks.

Brooding refers to the period immediately after hatch when special care and attention must be given to chicks to ensure their health and survival.

Broody refers to a hen that is sitting on eggs with the intent of hatching them.

Candle is to examine the contents of an intact egg with the use of a light.

Candler refers to the light used to examine the contents of an egg without breaking it open.

Candling refers to using a candler to check the contents of an egg.

Chick refers to a young (baby) chicken.

Clutch refers to the group of eggs a hen decides to collect before becoming broody and hatching them.

Hatch is the process of the chick getting itself out of the egg.

Hatch Rate is the percentage of eggs that hatched into chicks. If 9 out of 10 hatch, the hatch rate is 90%.

Humidity refers to the amount of water vapor in the air inside the incubator.

Hygrometer is the device used to measure humidity.

Incubation Period is the amount of time each egg takes to develop completely. Example, chickens have a 21 day incubation period while ducks have a 28 day incubation period.

Incubation refers to the process of subjecting the eggs to ideal hatching conditions for the proper

amount of time while controlling heat and humidity in order to hatch chicks.

Incubator refers to an object used to incubate eggs which holds in heat and humidity.

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Infertile Egg is an egg that has not been fertilized.

Lockdown refers to the last 3 days of incubation when humidity is raised to the proper level and the incubator is not to be opened to prevent the loss of humidity.

Membrane is a thin, skin like coating surrounding the albumen.

Pip refers to the first little break a chick makes through the membrane and shell. The first step in hatching.

Quitter is an egg that has quit developing at some point during the incubation period.

Rearing refers to the remainder of life after brooding until sexual maturity.

Set refers to the act of putting the eggs in the incubator to start the incubation process.

Shrink Wrapped is when the membrane of a hatching chick becomes too dry and it shrinks around the chick. Often it inhibits movement to the point that the chick cannot move to continue hatching.

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Still Air refers to the air inside an incubator without any artificial air circulation.

Temperature refers to the degree of heat present inside the incubator.

Thermometer is an object that measures the degree of heat inside the incubator.

Turn or turning Eggs refers to the process of rotating eggs several times a day to keep the chick forming uniformly.

Turner is a rack or device inside incubator on a timer that turns eggs.

Zip refers to the process of turning inside the egg while breaking through the shell repeatedly in order to be able to remove the top of the egg and hatch out of it.

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RESOURCES AND FURTHER READING

Brooding and Rearing the Home Meat Flock. Earl Gleaves, University of Nebraska

Dekalb Hatchery Manual. 1990. Dekalb, Ill.: Dekalb Poultry Research Veterinary and Technical Services.

Embryology 1: Hatching Classroom Projects, Helper's Guide Beginner Grades 2-5, 2002, Leader's Guide LG1502. MU Extension, 573-882-7216.

Embryology 2: Experiments in Poultry Science, Helper's Guide Advanced Grades 6-8, 2002, LG1503 Leader's Guide. MU Extension, 573-882-7216.

Guide to raising healthy chickens (English; Spanish). Adam Hady and Ron Kean, University of Wisconsin.

Helpful Hints for Teachers on Incubation and Embryology of the Chick. Shrack, Joseph E., and Michael J. Darre. 1992. Cooperative Extension System, University of Connecticut, Storrs.

How to Keep a Small Poultry Flock. Ron Parker, New Mexico State University.

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Improving Hatchability, Taylor, Gib. 1994, Medina, Ohio: Chick Master Incubator Company.

Management Requirements for Waterfowl. Phillip Clauer, Virginia Tech

Managing a Family Chicken Flock. Jesse Lyons, University of Missouri

Key Takeaway

Local sources of information about brooding include hatcheries, feed and farm supply firms, and drug stores that deal in animal health products.

Enjoy the journey of incubating and brooding poultry!

God bless!